Cement MILL SECTION of

Concrete

Vol. 25 OCTOBER, 1924 No. 4

The Centenary of Portland Cement

Americans Pay Tribute to Joseph Aspdin

A number of American cement manufacturers assembled at Leeds, England, September 8, 1924, to pay tribute to Joseph Aspdin, the inventor of portland cement and to participate in the unveiling of a bronze tablet erected in the Leeds Town Hall. The memorial was presented by Frederick W. Kelley, president of the Portland Cement Association on behalf of the American association to the British Cement Makers' Federation in commemoration of the centennial of the patenting of portland cement.

The inscription on the tablet states that it is in memory of Joseph Aspdin, of Leeds, whose invention of portland cement, patented October 21, 1824, followed by a century of improvement in its manufacture and use, had made the whole world his debtor.

Aspdin was referred to by Mr. Kelley as one of a distinguished number of his countrymen like John Smeaton who discovered the reason for the hydraulic properties of cement or Isaac Johnson who perfected the process of portland cement manufacture, thus giving to the world one of the most widely used and important building materials. Progress was made by men who saw beyond their neighbors and who acted upon their visions. Aspdin, without modern tools and without modern knowledge, did see, and took a distinct and progressive step.

In his address, Mr. Kelley stated it was estimated that over 50,000,000 tons or 260,000,000 bbls. of portland cement were used throughout the world in 1923, and that there was every prospect that this amount, vast though it was, would be considerably exceeded in the near future when the value of concrete was more appreciated by the peoples of the world in general. "All honor to British pioneers and especially to Joseph Aspdin, a pioneer in that branch of industry we call ours. He did more, literally, to bind the world together than all the diplomats of all time," Mr. Kelley concluded.

The monument which had been covered with the Union Jack and the Stars and Stripes was unveiled by Mr. Kelley, and accepted in the name of the City of Leeds by Sir Edwin Airey, Lord Mayor, who expressed a peculiar satisfaction that the celebration of the centenary of Aspdin's invention should have taken place in his year of office.

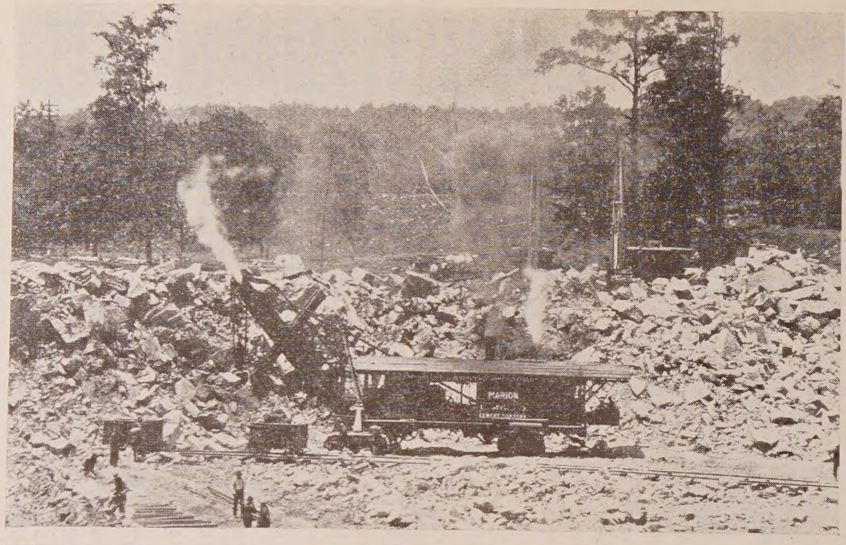
P. M. Stewart, chairman of the British Cement Manufacturers' Federation said that there was now a belief in England that they were on the verge of the concrete age. In America, he stated, they had already seen the dawn. That was a concrete fact.

An interested spectator of the unveiling ceremony was Joseph William Aspdin, a great grandson of the discoverer of portland cement.

Among those who took part in the centennial celebration at Leeds were:

F. W. Kelley, president, Helderberg Cement Co., Albany, New York; F. W. Kelley, Jr.; J. W. Boardman, vice president, Huron Portland Cement Co., and Wyandotte Portland Cement Co., Detroit, Mich.; H. R. Browne, in charge, Chemical and Technical Activities, Michigan Alkali Co., Detroit, Mich.; Morris Kind, president, Hercules Cement Corporation, Philadelphia, Pa.; D. A. Abrams, professor-in-charge, Structural Materials Research Laboratory, Chicago, Ill.; F. E. Tyler, president of the Dewey Portland Cement Co., Kansas City, Mo.; William M. Kinney, general manager, Portland Cement Association, Chicago, Ill.; A. C. Tagge, vice president, Canada Cement Co. Ltd., Montreal, Canada; Ernest Ashton, chemical engineer, Lehigh Portland Cement Co., Allentown, Pa.; R. P. Butchart, president, British Columbia Cement Co., Victoria, B. C., F. G. McKelvy, vice president, Alpha Portland Cement Co., Easton, Pa.; H. A. Schaffer, conservation engineer, Portland Cement Association, Chicago, Ill.; S. W. Traylor, representing New Egyptian Portland Cement Co., Detroit, Mich.; J. C. Eden, president, Superior Portland Cement Co., Seattle, Wash.; and the following representatives of the British Cement Makers' Federation: P. M. Stewart, chairman, F. T. Halford, vice-chairman, Brig.-General A. C. Critchley, G. F. Earle, L. Lister-Kaye, S. G. Robinson, E. A. Browne, secretary, and H. M. Brabant, assistant secretary.

The fall meeting of the Portland Cement Association will be held in Chicago, November 17-19, 1924, and plans are being made for a celebration as America's tribute to the inventor of portland cement.



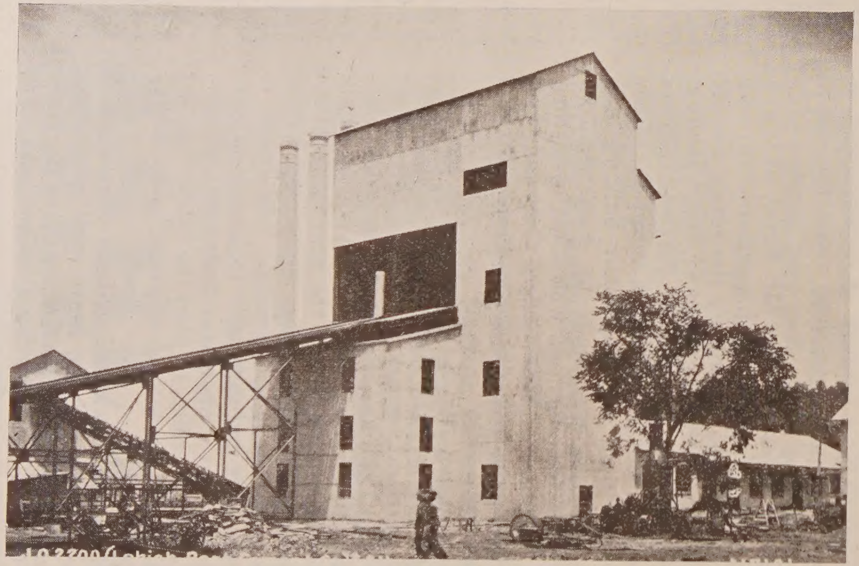
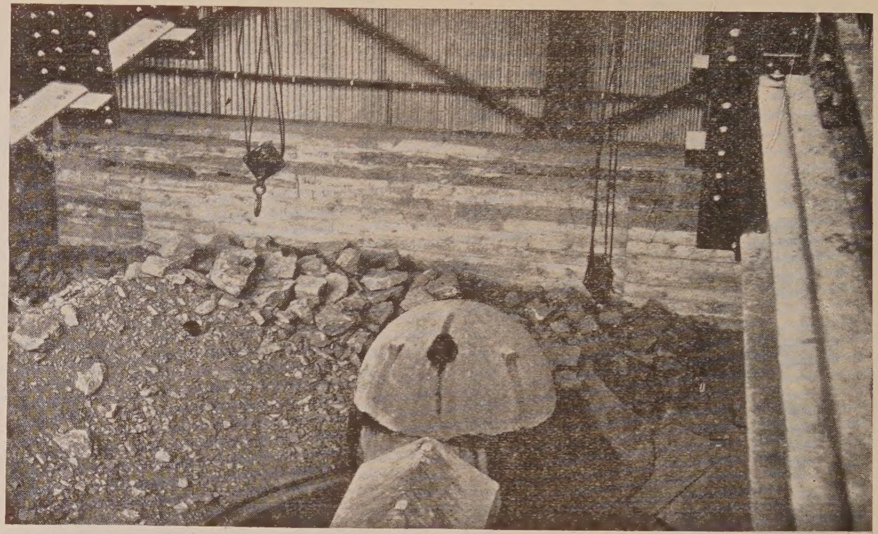


Fig. 4—A Close-Up View Showing Quarry Shovel in Operation, with Drills Working in the Background, Lehigh Portland Cement Plant

Fig. 5—Crusher Building, Looking West



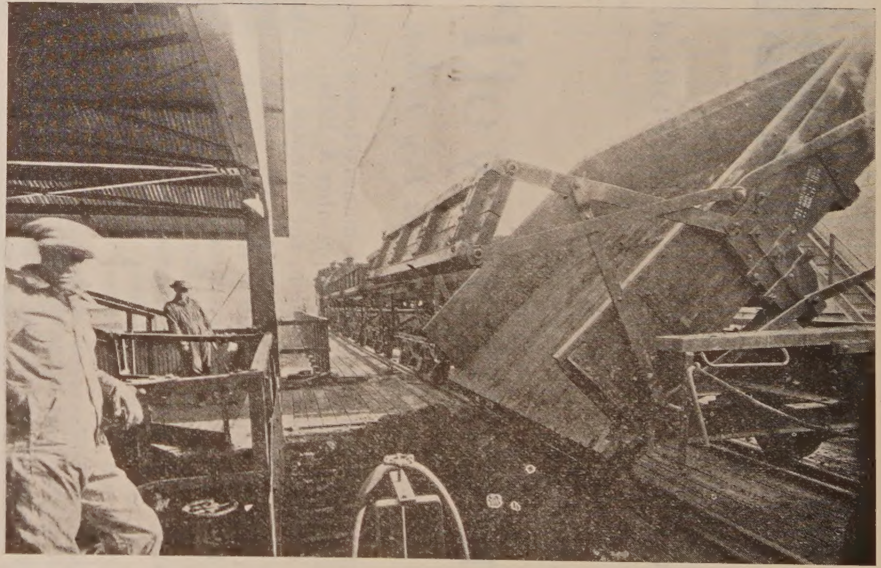


Fig. 6—Charging Bin, Crusher Building, Looking North

Fig. 7—Unloading Clay from Side Dump Cars

The New Wet Process Plant of the Lehigh Portland Cement Company

If Joseph Aspdin could awake at the present day after the century which has elapsed since his operations which brought to him the credit for the discovery and first commercial use of portland cement, and if the awakening could take place in the new Birmingham plant of the Lehigh Portland Cement Co., Aspdin would not only be amazed at the progress made in the industry he founded, but would fail to see much in common in the methods of the two dates. Except for certain basic principles, there is little to link the manufacture of portland cement of today in one of the most up-to-date and efficient plants recently put into operation with Aspdin's early operations. Aspdin's specification in his patent papers mentions a mixture of powdered limestone and argillaceous earth or clay with water to form a slip, indicating the wet process. The wet process, as we understand it today, is carried out in the Lehigh Company's sixteenth and newest plant, located a few miles north of Birmingham.

The first construction work on this plant was started in November, 1922, and clinker was first produced on August 16, 1923, about nine months later. Cement was produced September 1, 1923. Until recently the plant was operated as a three unit plant but the fourth unit has just been completed, giving a total capacity of about 5000 bbls. per day. By exercising ingenuity in construction of the new unit the work was carried on, the new equipment installed, and the buildings enlarged as necessary, without any interference with production.

The ultimate importance of, and necessity for, an intimate mixture of raw materials and for a high temperature in the kiln, emphasized by Aspdin, are still recognized and with these ideas in mind, the designers of the Lehigh plant made each step in the manufacturing process a link in a chain of uniformity. As a result of their efforts, a uniform mixture is obtained, clinker of uniform size and easily ground is produced, and the result is an extremely good product.

The Lehigh plant is strategically located with regard to railroad facilities and the sources of raw materials used in making portland cement. Limestone, clay and silica are all available practically at the site of the plant; coal and gypsum are shipped to the plant from their respective sources.

Limestone is quarried at the plant, a very good grade for cement rock being available with an average of only 6 to 18 inches of material to be stripped and carted to one side.

The dip of the limestone rock at the quarry is about 45°. The face of the quarry is worked by well drills and the rock is further broken up with the aid of jack-hammer drilling until it can

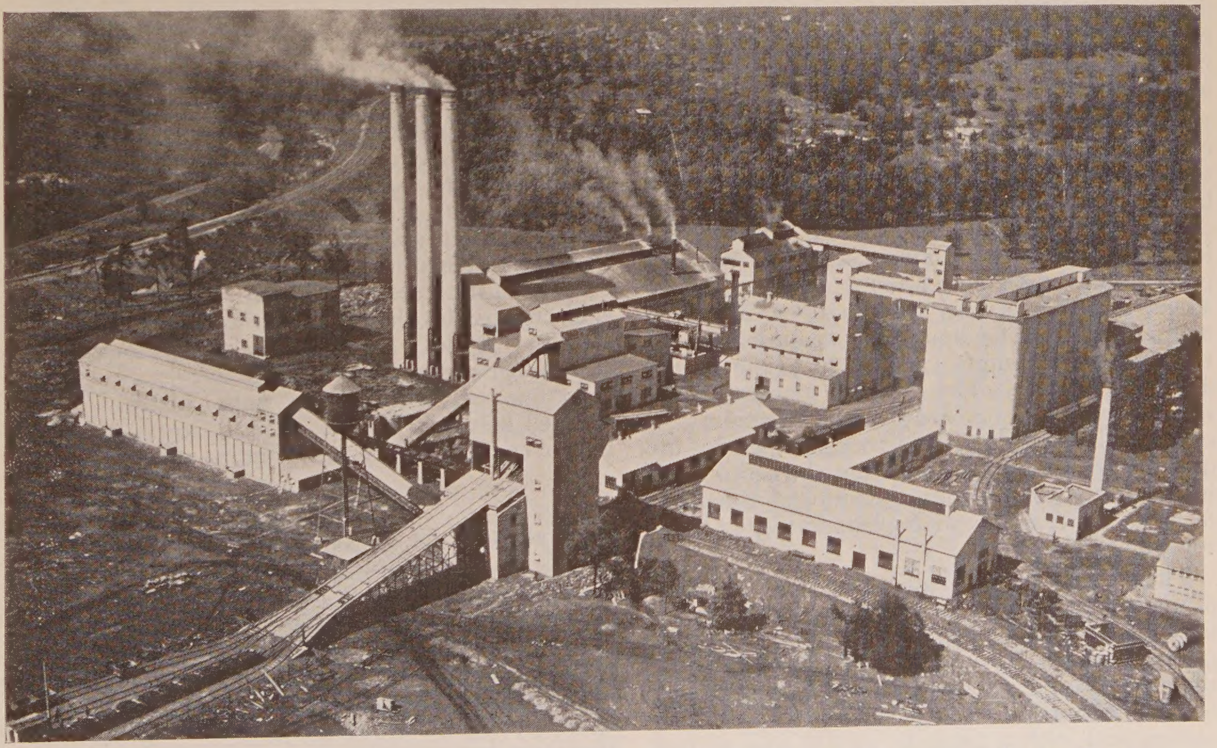


Fig. 1—Airplane View Showing the General Arrangement of the Birmingham Plant of the Lehigh Portland Cement Co. Just Before the Fourth Unit Was Added

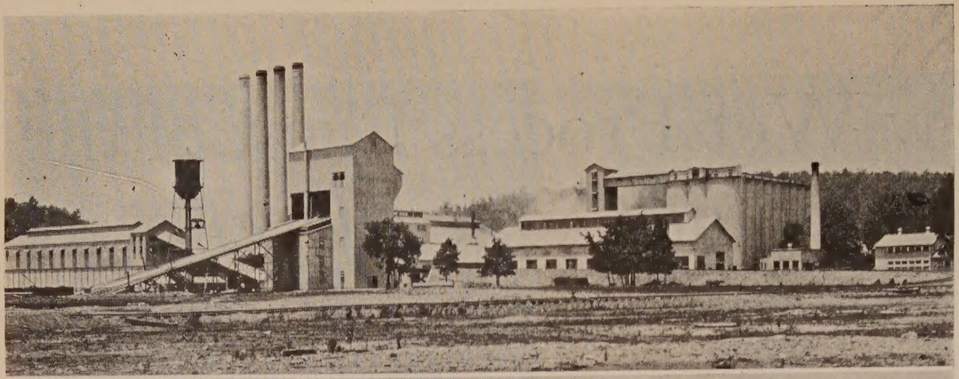


FIG. 2—GENERAL VIEW SHOWING THE FOUR KILN STACKS JUST BACK OF THE CRUSHER BUILDING

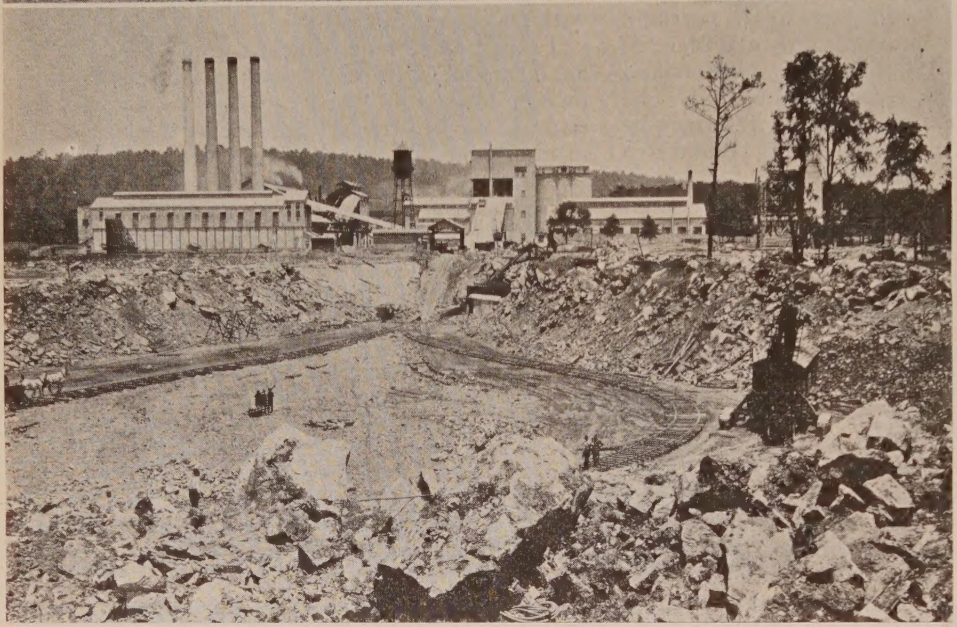


FIG. 3—LOOKING ACROSS THE QUARRY TOWARD THE PLANT

be handled by the 2½-yd. shovel dipper.

Caterpillar treads on the shovels have proved efficient in every respect and allow the shovel to move out in 2½ minutes when a shot is to be fired and then to move back in again without further lost time. This obviates the expense and lost time ordinarily required for moving tracks.

The shovel loads the rock onto a standard gauge car having an average capacity of five tons and the cars are hauled by gasoline locomotive to the barney pit, to be hoisted up the incline to the crusher building. An electric hoist controlled from the top of the incline pulls the cars to a position where they can dump directly into a 42 in. gyratory crusher, driven by a 200 h. p. motor. After being dumped automatically into the crusher, the empty cars return to the quarry down the incline. The primary crusher, which reduces the rock to about 5-in. fragments, is capable of taking any sized rock handled by the quarry shovel, and by obviating the necessity of breaking up any arches that might otherwise form in the crusher, an important step is taken toward "safety first."

The primary crusher discharges direct to feeders of the conveyor belt type and then to two 42x48 in. hammer mills, each driven by a 200 h. p. electric motor; the hammer mills further reduce the material and discharge onto a 30-in conveyor belt inclined at an angle of about 19°, 180 ft. on center, and with a capacity of 200 tons of rock per hour.

At the end of the stone storage building the stone conveyor discharges onto another belt conveyor which distributes the material by an overhead traveling tripper into the stone storage bins, having a capacity of 6500 tons of limestone ranging from ¾-in. size to dust.

The limestone is taken out of the bottom of the storage bin by means of a shaker trough or reciprocating feeder driven by the same pulley which runs the conveyor belt to which it discharges. There are 60 openings in the bottom of the storage bin and the feeder is in four units so that the raw material can be drawn from any or all parts of the storage, as desired. As the material is discharged by the reciprocating feeder in small amounts at the various openings, it drops onto two rubber conveyor belts which in turn discharge onto one belt running at right angles. This inclined belt conveys the material to the storage bins over the primary raw grinding mills.

CLAY

Paralleling the quarring of limestone as described, clay—the other principal raw material—is secured from the clay field about ¾ mile north of the plant. It is dug from a hillside by a small, electric shovel, loaded into 6-yd. side-dump cars and hauled by a 40-ton, saddle tank locomotive over standard gauge track to the wash mill located near the stone storage. At the wash mill, the clay is dumped through a grizzly which removes all roots and foreign matter, and approximately

60% of water is added to form the clay slip. A screen at the discharge opening of the wash mill removes all pebbles from the slip. Any silica lacking in the clay is provided by sandstone secured from a supply on the company's property immediately adjoining the clay field.

From the wash mill the slip passes into one large storage tank with three mechanical agitators which prevent the clay from settling to the bottom. The clay slip is next pumped by motor driven duplex plunger pumps through a cast iron pipe line to the clay feeder, located at the top of the raw mill, parallel to the limestone storage bins.

The limestone is fed by means of cradle feeders into the kominuter, each driven by a 150 h. p. synchronous motor through a magnetic clutch, and at the same time clay is fed through a rubber hose into the feed hopper of the kominuter. The amount of limestone fed into a kominuter is regulated by the number of strokes of the mechanical feeder and the amount of clay fed is regulated by different sized openings in the discharge from the clay feeder, it being possible to obtain any percentage of clay by regulating the size of orifice used in connection with the discharge valve and a hinged spout. The two materials are combined and ground so that 55% passes a 100-mesh screen and sufficient water is added at the kominuter to make a slurry about 32% water. The slurry passes from the grinding mills into an elevator discharging into a trix classifier, with screened openings 5/64-in. x ½ in. Material rejected from the screen is discharged from the classifier back to the primary grinding unit. Material passing through the screen is discharged into a slurry trough mechanically agitated and kept at a constant head at all times to assure a uniform feed to the tube mills.

The amount of material passing through the tube mills is regulated by a valve with orifices that can be adjusted, with openings graduated so as to always indicate just how much material is going to the mill. The material feeds from the valves into a slurry pot forming a feed hopper to the tube mill. The slurry is next discharged from the tube mills through a screw conveyor into the concrete correcting tanks each having a 500-bbl. clinker equivalent capacity. The object of the correcting tanks is to provide a means for discharging slurry from the tube mill so it can be analyzed and if found not of the desired lime content, it can be held and a complementary tank of slurry made. When the two tanks are discharged together into a large mixing tank equal in capacity to the three correcting tanks, absolute control of the mix is assured—another link in the chain of uniformity.

The correcting tanks and mixing tank are all equipped with mechanical and air agitators; air is forced into the tanks through openings in the sides, giving thorough agitation of the slurry. Slurry from the mixing tanks is handled through air lift tanks and piping to the three slurry storage tanks, each having a clinker equivalent capacity of 2500 bbls. From the storage tanks the slurry is pumped by power driven duplex plunger pumps into a slurry feeder at the top of the kiln buildings from which it discharges through individual feed pipes to each kiln. The material in the feeder is constantly agitated and the amount fed to each kiln can be controlled by means of a cable system by the burner in front of the kiln. The cables in this system are connected to hinged spouts at the feeder and the angle to which these spouts are adjusted determines the amount of slurry allowed to enter the feed pipe of the kiln.

The kilns are each equipped with a 14-in. ring baffle to prevent the slurry from backing up from the feed end. Each kiln is also equipped with quarter section tumblers—plates set at right angles and dividing the cross section of the kiln into four quadrants—which keep the material thoroughly stirred up until it has passed at least 30 ft. of the length of the kiln. This is another precaution to insure the intimate mixture of the raw materials.

The tube mills are each driven by a 300 h. p. synchronous motor and equipped with a magnetic clutch. One kominuter and one tube mill make up one grinding unit for each kiln.

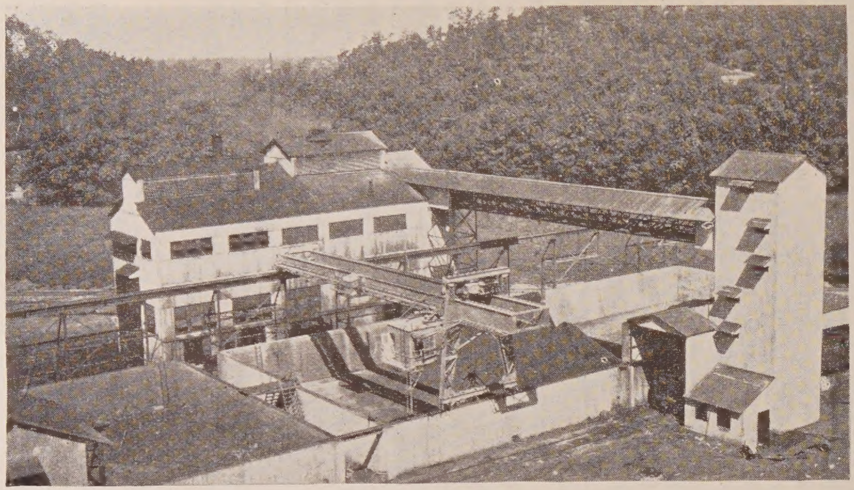
COAL

The coal grinding department is practically dust proof—as dust proof as it can be made. The coal is shipped in and unloaded into a track hopper from which it passes through a disintegrator to crush any large lumps, and it is then elevated to a conveyor belt which passes overhead across the coal storage discharging normally into storage bins back of the coal dryers. From these bins it discharges through automatic scales into coal dryers where it is dried by burning gases from pulverized coal. From the dryers, it discharges into an elevator and thence into a distributing conveyor over the bins supplying the coal grinding mills. From these mills it is discharged into a screw conveyor and thence to the pump that forces the pulverized coal through a pipe line to the pulverized coal storage tanks for supplying the kilns and to the tank supplying the pulverized coal for the coal dryer. Each bin is equipped with electrically controlled indicator whereby coal after filling the bin is automatically shut off and discharged into the next bin. In case all bins are filled a horn signal is given and the operator can shut down the grinding mills. The qeuipment of dust collectors makes a very clean coal grinding department.

When the coal tanks back of the dryer are filled, the same overhead belt that carries the coal from the unloading hopper and elevator can be tilted and the surplus coal discharged into the coal storage to be reclaimed at any time by means of a belt in the tunnel located under the storage. Any coal not immediately over the tunnel is handled by the overhead crane serving both the clinker and coal. This tunnel belt discharges through the same disintegrator, elevator and overhead belt as when cars are unloaded to the bins of the dryers.

KILNS

There are four kilns now in operation, each 11 ft. 3 in. x 10 ft. x 190 ft. The smoke chamber and stack breeching are so designed in line that in case it is desired to install a waste heat boiler at a later date the boilers can be attached without any changes. The front hoods of the kilns are specially designed for the purpose of accommoda-



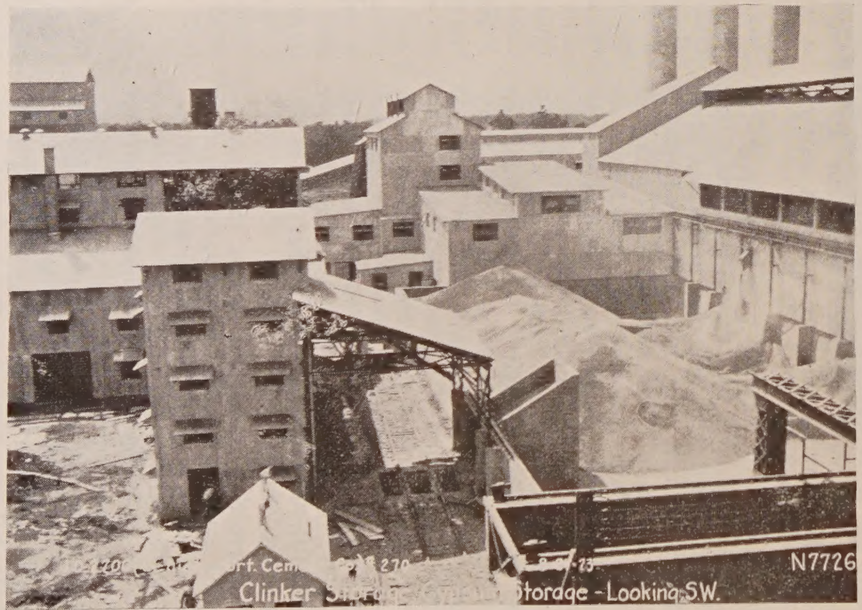
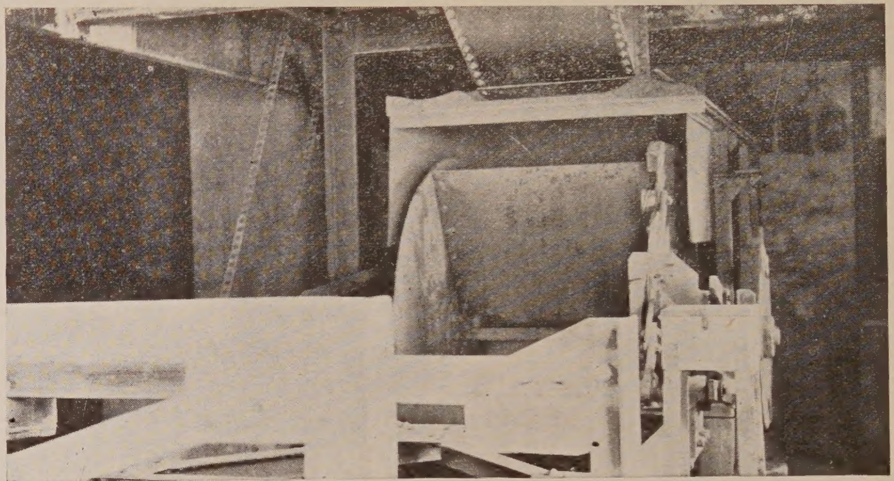


Fig. 8—Coal Mill, Coal Elevator, Coal Storage, Looking Northwest
Fig. 9—Clinker Storage, Gypsum Storage, Looking Southwest



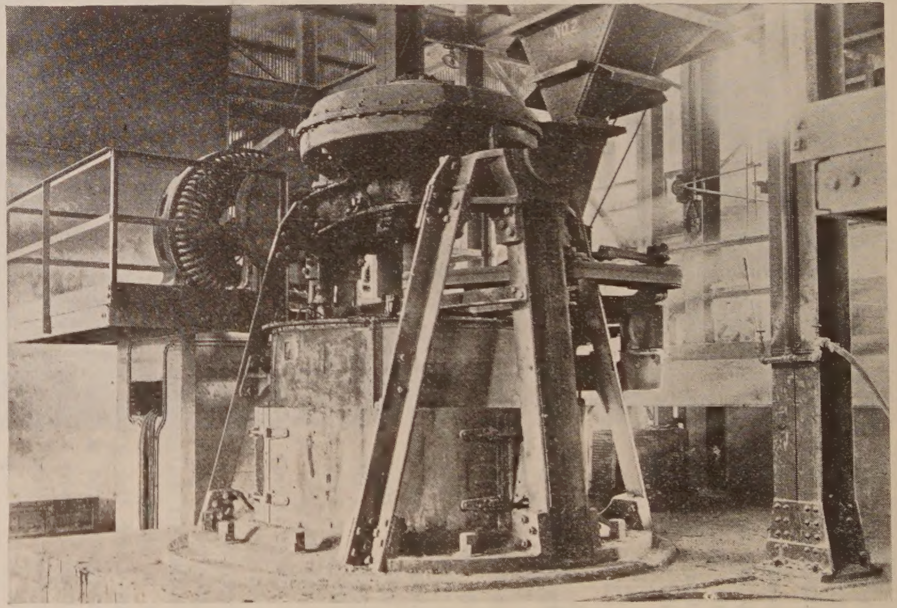


Fig. 10—Clinker Scale in Clinker Mill, Looking East
Fig. 11—Hercules Mill for Grinding Clinker

ting waste heat from the pressure coolers and using it to augment burning in the kilns.

Air entering the coolers at the feed end is forced through openings in the 8-in. space between the shelf and the lining. Each cooler lining is equipped with spiral tumblers running one-half the length of the cooler. Air forced into the discharge end of the cooler meets air that is hot and dissipated and forces it up into the kiln. A stack with damper allows regulation of the amount of pre-heated air that is forced from the coolers into the kiln.

Experience at the plant demonstrates that the heat saved with this arrangement of kiln and cooler and the power saved due to the fact that the clinker is cooled quickly and consequently made more grindable, compensates for any extra coal required due to the use of the wet process of manufacturing cement. Pulverized coal, normal air and pre-heated air from the coolers are regulated as the burner desires.

The coal is fed to the kilns by twin feed screws direct connected to motors by gear reducers. Air is blown into the kilns through 10-in. feed pipe by fans driven by direct connected induction motors, one unit being provided for each kiln.

The burner regulates the stack draft, the feed into the kiln, the speed of the kiln, the amount of pre-heated air, and the coal and air feed in the main pipe. The pulverized coal and air feed is regulated by a slide valve in the pipe. The coal feed is driven by a variable speed motor and the fan by a constant speed motor. Each kiln is driven by a 75 h. p. belt connected, variable speed motor.

Special attention is given to the lubrication of the heavy equipment. In lubricating the bearings of the tube mills, a high melting point grease is used, as also in the packed bearings of the kilns. A gear grease is put on hot so as to cling to the gear teeth while the equipment is in use.

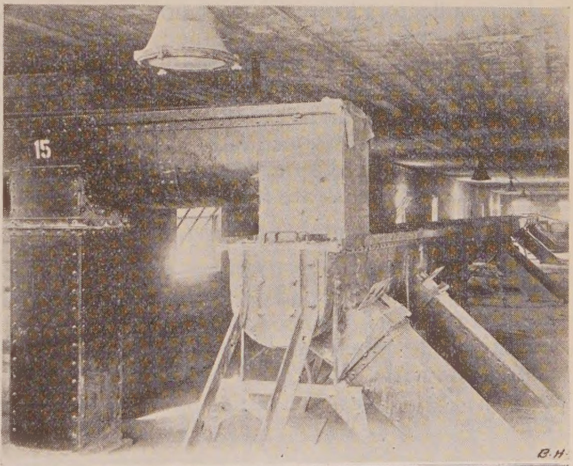
CLINKER

Under ordinary operating conditions the kilns discharge into the coolers, but in case repairs to a cooler are necessary an arrangement is provided whereby a spout can be pulled back, causing the clinker to discharge into a hot drag at the front end of the kiln, through a clinker dust chamber. The cold drag conveys the clinker from the cold end of the cooler. Ordinarily the clinker is conveyed through a tunnel under the clinker storage by two drags onto a scale in the clinker mill where the clinker is automatically weighed and the necessary gypsum added automatically or can be diverted into an elevator thence to storage. This weighing equipment is of special design, equipped with friction brake and recoil cylinders to cushion it when it dumps. The front drag line deposits hot clinker into an elevator discharging into the clinker storage.

The clinker storage is equipped with an overhead gantry crane, with an 80-ft. span and a 3-yd. bucket, which reclaims the clinker over the tunnel in which the cold clinker drag operates.

The gypsum storage adjoins the clinker storage and it is so arranged that gypsum is unloaded from the cars into a hopper under the railroad track and carried by an apron feeder into an elevator in the gypsum storage building. This elevator carries it to the top of the building where it discharges onto a conveyor belt running across the top of the gypsum bins to a bin immediately over the scales in the clinker mill. If the gypsum is needed for immediate use, it is allowed to go directly to the bin over the scales in the clinker mill. If it is not needed immediately, it is discharged by means of scrapers on the same belt into the gypsum reserve storage bin. If gypsum is required from storage it is tapped onto a belt in a tunnel under the storage, conveyed to the same elevator which originally elevated the gypsum from the track hopper and is carried again to the belt over the top of the gypsum storage bin into the top of the gypsum bin over the scales. In other words, the same elevator and belt handles it for reclaiming storage in reserve bin or carrying it to the clinker scales.

After being properly proportioned at the clinker scales, the combination of clinker and gypsum is deposited on a drag line overhead in the clinker mill which carries the material to the bins over the mills for fine grinding. From these mills it is discharged into a screw conveyor and again elevated to a screw that runs across the bin over the tube mills. From the tube mills the cement passes into discharge conveyor which carries it to a double lift elevator and thence to a screw conveyor across the bridge from the clinker grinding mill to the top of the cement storage silo. Here it is distributed into the various silos by means of spouts and slides over various points as desired.



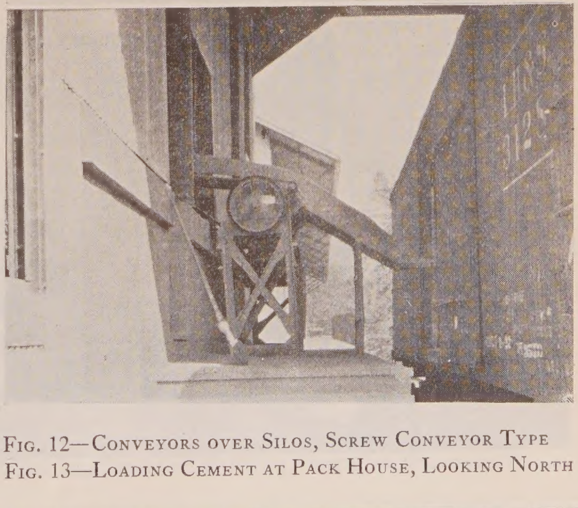


Fig. 12—Conveyors over Silos, Screw Conveyor Type
Fig. 13—Loading Cement at Pack House, Looking North

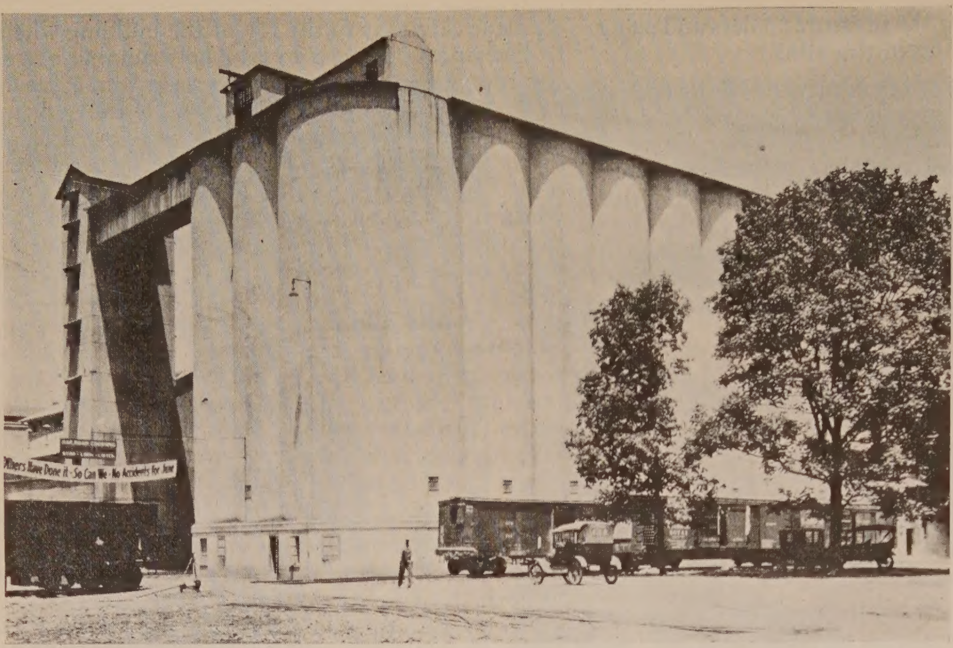


Fig. 14—Silo Cement Storage

The cement storage consists of ten silos 70 ft. high and 30 ft. in diameter, with outside pockets and inside star bins, having a total capacity of 155,000 bbls. Spouts and screw conveyors discharge into elevators where the cement is elevated into a conveyor and distributed to bins over the packers in the pack house. There are four automatic packers, each two of which discharge onto belt conveyors carrying the filled cement bags to cars on either side of the pack house.

Dust collectors keep the pack house practically free from dust. Bags are cleaned, repaired and tied in a bag house adjoining the pack house and connected with it by a tunnel through which they are taken in bundles to the packing machines. The filled bags are dropped onto a conveyor which takes them to the cars on the adjoining tracks for loading as shipments are made.

Shipping Facilities

Cement is loaded into cars received at the plant from the various railroads into Birmingham at an interchange yard owned and operated by the company, one mile from the plant; this yard being connected with the plant by the company's track. This gives an outlet on ten different railroads.

Power

Power is secured from the Birmingham Railway Light & Power Co., served in turn by the Alabama Power Co. Current is delivered at 13,000 volts at the company's sub-station, stepped down to 2300 volts for all large motors and stepped down in turn to 440 volts for small motors at individual substations, located in each building. The station is also equipped with a gasoline engine connected by a magnetic clutch to a motor generator set whereby a sufficient current can be generated to light the plant and turn the kilns in case the main source of power is shut off.

All tanks, silos and stacks are of monolithic reinforced concrete. Retaining walls are solid concrete. The coal building is of structural steel with asbestos cement corrugated siding and roofing. The kiln building, crusher building, part of the raw mill and the gypsum storage are of structural steel and corrugated iron. The remainder of the raw mill is steel and stucco with cement tile roofing. The bag house is of steel and corrugated iron. The office, hospital and change house are frame with stucco and asbestos shingles.

The chemical and physical laboratories and shipping and time clerk's and superintendent's

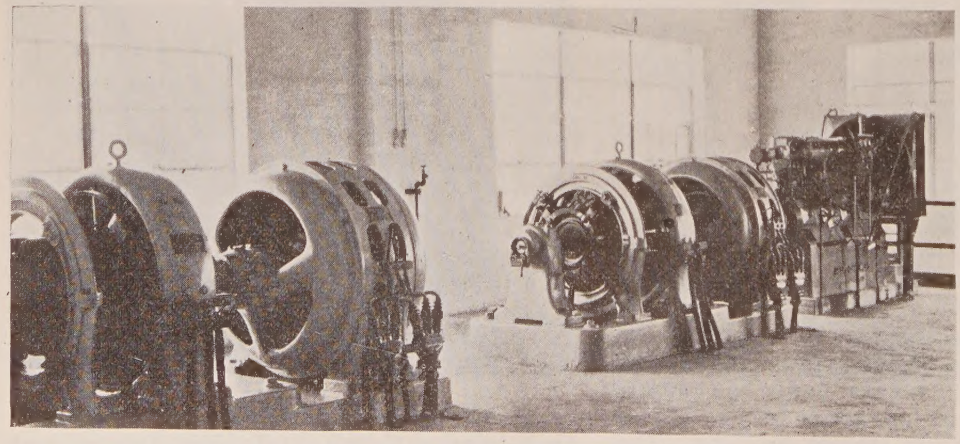


Fig. 15—Main Sub-Station—Motor Generator

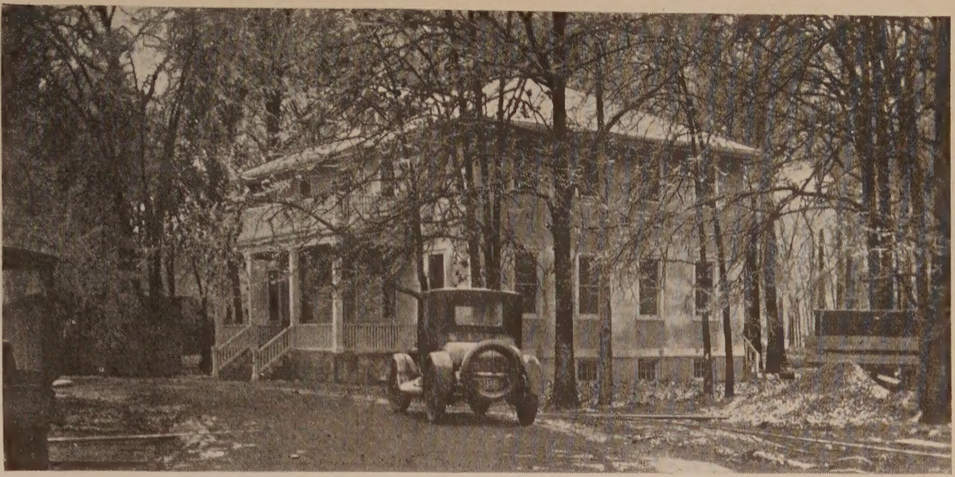


FIG. 16—OFFICE BUILDING, LOOKING NORTHWEST

offices are in the main office building at the plant. Sales offices of the Lehigh Portland Cement Co. for the Birmingham district are in the Woodward Building, Birmingham.

A foreman's change house is equipped with shower baths and lockers and there are also provided separate change houses and toilets for white and black employes. These are equipped with showers, face basins and metal clothes baskets. The latter may be pulled up high to the ceiling by chains running over pulleys, to remain suspended out of reach. The chains can be locked, so that in addition to providing good ventilation for the clothing, petty thieving is done away with.

Hot water heating and return system lines are all enclosed in concrete tunnels underground. A central hot water heating plant heats all buildings and furnishes hot water for the change houses.

A complete store room and machine shop is maintained for easy handling of replacements and ordinary repairs. In the machine shop each machine is driven by an individual motor which permits the operation of the shop on a very economical basis, particularly in view of the arrangements for purchasing power.

The emergency hospital, a separate building near the office building, is fully equipped for giving all first aid attention in case of accident.

The entire plant is fully equipped with drinking water service and water system with fire plugs and hose houses and reels strategically located around the plant. A wide concrete paved highway system has been laid out and constructed throughout the plant connecting the principal parts.

In its entirety, this wet process cement plant of the Lehigh company has been made as complete and as safe and agreeable for workmen employed in connection with the manufacturing process as present-day knowledge and engineering seem to permit. The main offices of the company are in Allentown, Pa.

Among the company's officials are some who might well be termed pioneers in the American cement industry. R. H. MacFetridge is the superintendent in charge of the plant and represented the company in the field during construction of the plant.

August Cement Production Makes High Record

The statistics shown in tables issued by the Department of the Interior, and prepared under the direction of Ernest F. Burchard, of the U. S. Geological Survey, indicate that production and shipments for the month of August, 1924, once more made a new high record. Stocks were higher than at any corresponding period since 1917.

PRODUCTION SHIPMENTS, AND STOCKS OF FINISHED PORTLAND CEMENT, BY DISTRICTS IN AUGUST, 1924, AND STOCKS IN JULY, 1924, IN BARRELS

Commercial District	Production August 1924	Shipments August 1924	Stocks at end of August, 1924	Stocks at end of July 1924(a)
Eastern Pa., N. J. & Md...	3,621,000	4,263,000	2,092,000	2,734,000
New York................	803,000	942,000	645,000	784,000
Ohio, Western Pa. & W.Va.	1,707,000	1,882,000	1,018,000	1,193,000
Mich..................	1,105,000	1,175,000	459,000	528,000
Wis.(b), Ill., Ind. & Ky....	2,133,000	2,529,000	1,554,000	1,950,000
Va., Tenn., Ala. & Ga.....	1,049,000	1,241,000	414,000	606,000
Eastern Mo., Ia. & Minn..	1,596,000	1,660,000	2,046,000	2,110,000
Western Mo., Neb., Kan. & Okla................	1,033,000	1,036,000	1,134,000	1,137,000
Texas..................	414,000	433,000	245,000	264,000
Colo. & Utah...........	283,000	259,000	191,000	167,000
Cal.	1,063,000	1,056,000	333,000	326,000
Ore., Wash. & Mont......	321,000	379,000	462,000	520,000
	15,128,000	16,855,000	10,593,000	12,319,000

(a) Revised. (b) Began producing June, 1924.

PRODUCTION, SHIPMENTS, AND STOCKS OF FINISHED PORTLAND CEMENT, BY MONTHS, IN 1924, IN BARRELS

Month	Production 1924	Shipments 1924	Stocks at end of month 1924
January..............	8,788,000	5,210,000	14,155,000
February.............	8,588,000	5,933,000	16,815,000
March................	10,370,000	8,995,000	18,189,000
1st Quarter..........	27,746,000	20,138,000	....
April................	11,726,000	12,771,000	17,159,000
May..................	13,777,000	14,551,000	16,403,000
June.................	13,538,000	15,036,000	14,903,000
2nd quarter..........	39,041,000	42,358,000	....
July.................	14,029,000	16,614,000	(a)12,319,000
August...............	15,128,000	16,855,000	10,593,000
September............	....	....	....
3rd Quarter..........	....	....	....

Stocks of clinker, or unground cement, at the mills at the end of August, 1924 amounted to about 5,355,000 bbls. compared with 6,646,000 bbls. (revised) at the beginning of the month.

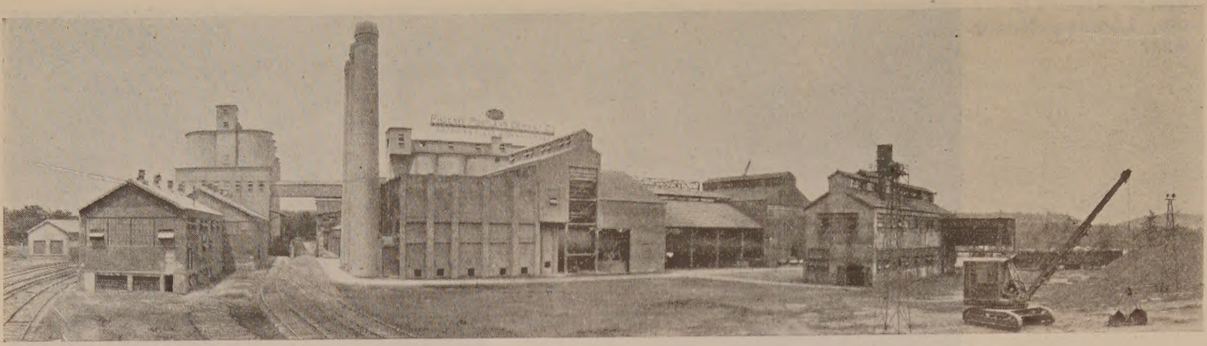


Fig. 1—Panoramic View of Phoenix Portland Cement Co.'s Plant from the Southeast

New Dry Process Plant Phoenix Portland Cement Company

In the creation of the region in Alabama referred to as the Birmingham district, the processes of nature were such as to endow that section with valuable mineral resources. It is not unusual to find, within a small radius, such materials as coal, clay, shale, limestone, and iron ore. All but the latter are raw materials extensively used in the manufacture of portland cement, and to Lindley C. Morton, president of the Phoenix Portland Cement Co., is attributed the discovery of the bed of limestone of proper chemical composition for cement raw material, at the site of the new Phoenix cement plant in the suburbs of Birmingham. This new Phoenix plant may be properly referred to as the last word in dry process plant construction, and every effort has been put forth to make it dustless, of pleasing appearance and permanent construction, and capable of turning out a uniform product of a high quality.

Portland cement manufacturers advocate concrete for permanence, and the officials of the Phoenix company are such firm believers in their slogan that concrete was used wherever possible and in the ways most suited to their needs in the construction of this new Birmingham plant.

There are a number of important and remarkable features about this new plant, one of which is the absence of dust. One does not usually expect to see a dry process cement plant without an accompanying cloud of dust surrounding certain departments,. but with the No. 2 Phoenix plant at Birmingham the forethought of the designers has so alleviated the dust nuisance that there is little, if any, dust escaping into the air to settle upon the surrounding country.

A complete General Electric floodlight system[1] surrounds the plant and quarry, making night operations as convenient and safe as daylight work. Concrete pavements have been constructed from the plant office to the main departments of the mill, and even these are kept free from dust by employes with hand sweepers and by mechanically operated sweeping machines.

Raw Materials

The materials—limestone and shale—which are used in making clinker in the new Phoenix plant, are in close proximity and are both readily obtainable. The plant proper has been located practically at a limestone quarry, where a start was made with a face 50 ft. high, and later another level opened up, making the quarry face 75 ft. high. This stone is of very high grade. The dip of the rock is about 35°.

Two Sanderson Cyclone well drills[2] are used to drill 35-ft. holes, 5⅝ in. in diameter. The rock shot from the quarry face, after being further broken up by X-70 Ingersoll-Rand drills,[3] is

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[1] General Electric Co., Schenectady, N. Y.

[2] Sanderson Cyclone Drill Co., Orrville, Ohio.

[3] Ingersoll-Rand Co., New York City

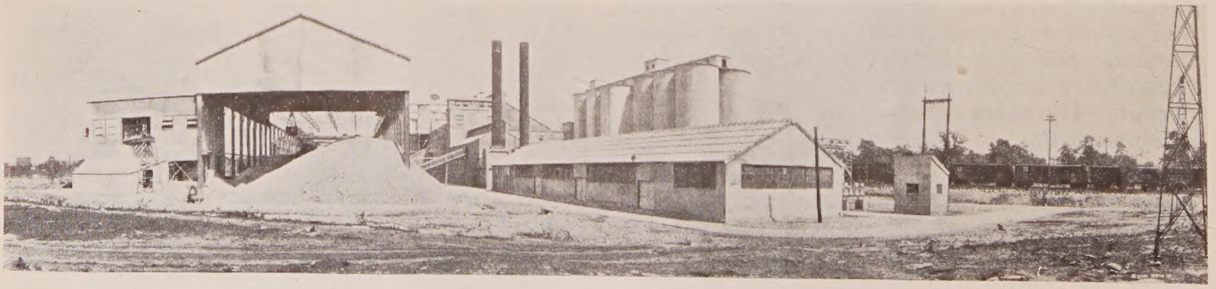
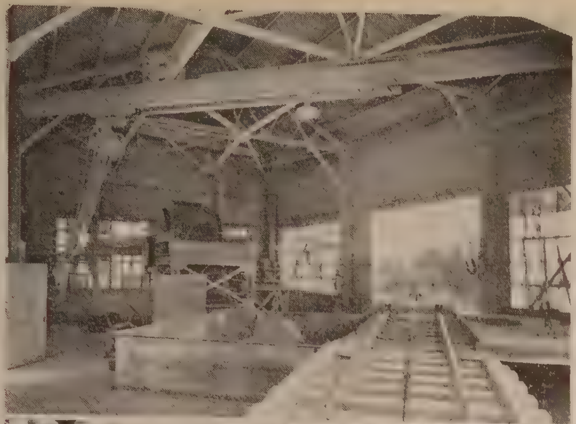


Fig. 2—Panoramic View from the Southwest Corner of the Plant



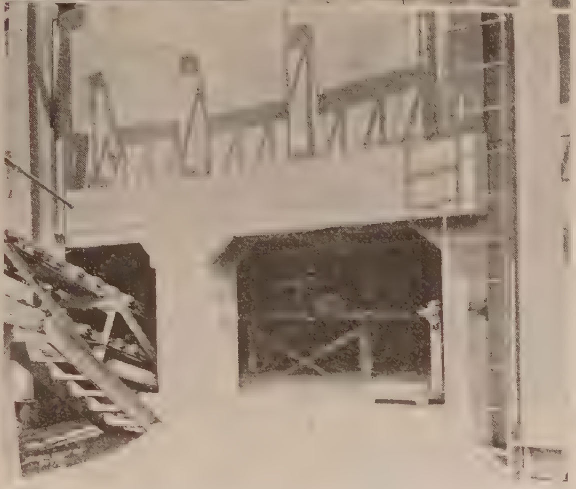


Fig. 3—View of Second Floor Crusher Building
Fig. 4—Showing Poidometers, Mix Bin, and Pan Conveyor Conveying Mix to Dryer Room

loaded with the aid of two Marion model 37 full revolving electric shovels,[4] with caterpillar treads and 1½-yd. dippers onto 8-ton, 42-in. gauge Easton all-steel cars.[5] A 17-ton Davenport steam locomotive and an 8-ton General Electric storage battery locomotive[1] haul the cars of rock to the foot of the incline, from where they are pulled up to the crusher building by a Flory hoist[7] of the cable drum type, equipped with a 105 h. p. slip-ring General Electric motor. The operator's stand for control of the hoist is so located that the operator can at all times watch the travel of the cars as they are hoisted, one at a time, from the floor of the quarry to the storage track.

The primary crusher is a 36-in. Worthington Superior gyratory,[8] driven by a 150 h. p. motor and discharging rock in 4-in. to 6-in. cubes to a 42-in. Link-Belt elevator[9] operating on 30-ft. centers. From the elevator, the rock passes to a Pennsylvania hammer mill[10] of the XT8 type, driven by a 200 h. p. motor, which further reduces the rock to 1½ in. or smaller. The elevation of the discharge outlet of the hammer mill is such that the crushed rock goes by gravity to the stone storage pit, where it is picked up by one of two 8-ton Champion cranes[11] with 80-ft. span, which distribute the rock throughout the length of the stone storage. Each crane is equipped with a cable-operated 3-yd. bucket, and they travel over a crane-way 400 ft. long. Instead of depositing the discharged rock in storage, the crane can also be used to convey it directly to the weighing and mixing bins, if desired.

Shale, which is used with the limestone in the raw mix, is shipped already crushed from the quarry, which is about 1½ miles from the Phoenix plant, over privately owned tracks in the Phoenix company's equipment. The shale quarry is hand operated, as the requirements amount to only about 250 tons per day. No stripping is necessary in the shale quarry. The first crushing of the shale takes place in a No. 5 Traylor gyratory,[12] and a 42-in. x 16-in. Traylor roll crusher further reduces the product to 1½ in. Shale is loaded by gravity into standard gauge cars from overhead bins having a capacity of 200 tons.

The shale deposit is so constituted that shale high in alumina occurs on one side of the quarry and high silica on the other side, so that the proper composition is obtained by loading part from each side, this is a distinct advantage, as it enables the company to exactly control the ratio of silica to iron and alumina in the finished product, standard gauge steel hopper cars being used for shale transportation. At the plant, shale is unloaded from the cars into a hopper, and thence is supplied under the crane runway to be picked up by the crane and discharged into the shale storage bin or into the mix bin, as desired. There are three reinforced concrete mix bins, each having a capacity of 800 tons.

The first mixing of the raw materials is done at the weighing bins, the mix being made by a 36-in. Schaffer poidometer[13] to handle limestone, and a 20-in. poidometer to handle shale. These dump the proper proportions of materials onto a 24-in. pan conveyor, which conveys the mix to the feed end of the dryers.

Moisture is driven out of these raw materials in two Vulcan dryers,[14] equipped with dust-settling chambers and fired with pulverized coal. Rock from the dryers is discharged onto a Link-Belt open top carrier, which in turn conveys, elevates, and discharges the material onto a drag conveyor over the top of the Bradley-Hercules mill[15] feed bins. There are four Bradley mills—two for raw rock and two for clinker grinding—however, the system is so connected by conveyors as to make raw grinding and clinker grinding mills interchangeable. Each Bradley mill is driven by a 300 h. p. slip-ring motor.

The raw material discharged from the Bradley-Hercules mills is elevated to bins over the Traylor tube mills,[12] where the finish grinding is done. These four tube mills are each 7 ft. x 26 ft. in size and charged with 52 tons of cylpebs. Each of the four mills is driven by a 500 h. p. synchronous motor connected to a 60-in. Cutler-Hammer magnetic clutch.[16]

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[4] Marion Steam Shovel Co., Marion, Ohio.
[5] Easton Car & Construction Co., Easton, Pa.
[6] Davenport Locomotive Works, Davenport, Ia
[7] S. Flory Mfg. Co., Bangor, Pa.
[8] Allis-Chalmers Mfg. Co., Milwaukee, Wis.
[9] Link-Belt Co., Chicago, Ill.
[10] Pennsylvania Crusher Co., Philadelphia, Pa.

[11] Champion Engineering Co., Columbus, Ohio.
[12] Traylor Engineering & Mfg. Co., Allentown, Pa.
[13] Schaffer Engineering & Equipment Co., Pittsburgh ,Pa.
[14] Vulcan Iron Works, Wilkes-Barre, Pa.
[15] Bradley Pulverizer Co., Allentown, Pa.

The tube mills are also interchangeable, making four separate units, consisting of a Bradley-Hercules mill and a tube mill, each of which can be utilized for raw or clinker grinding by means of the double system of conveyors provided.

Raw material discharged from the tube mills is conveyed, elevated, and discharged into any one of five reinforced concrete blending silos, each 17 ft. in diameter and 65 ft. high, as shown in an accompanying illustration, and having a capacity of 1500 bbls. each. These storage silos for the pulverized raw material play an important part in the proper proportioning of the raw mix and consequently in the production of a uniform finished product. Two bins are filled at a time, and the material is drawn from two at one time with variable speed feeders, giving the chemist an opportunity to blend his mix in accordance with the requirements as indicated by his analyses. The feed from the bin is regulated in accordance with the chemist's direction, and any desired mixture may be obtained by drawing from the various bins in the proper proportion with the aid of the variable speed feeders. The accuracy of the mix from the poidometers is the first step, and any irregularities in the mix are evened out by means of the feeders under the raw silos.

From the silos, the properly proportioned mix is carried by a Link-Belt conveyor, which discharges to other conveying equipment discharging into the raw mix feed bin, one of which is supplied for each kiln and each having a capacity of 400 bbls. The kilns are fed automatically at a constant speed.

COAL

A very satisfactory grade of coal, containing 13,000 B. t. u.'s per lb., is obtained at the Mary Lee Mine, about 1¼ miles from the main plant, and is carried to the coal mill in the company's equipment over a private railroad. Hopper bottom cars are dumped into a track hopper, from which the coal is elevated and discharged in turn into an indirect coal-fired Fuller-Lehigh dryer,[17] 5 ft. 6 in. in diameter x 42 ft. long.

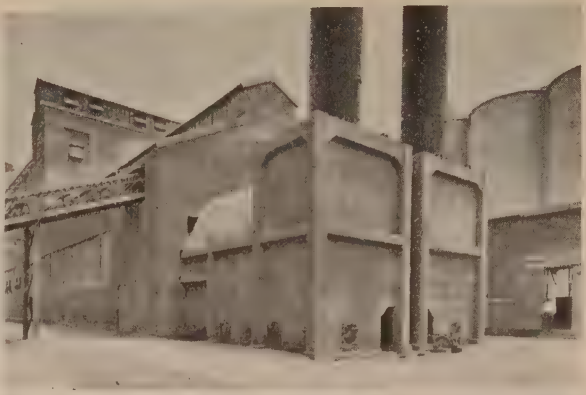
From the dryers, the coal is fed to three gear-driven 42-in. Fuller mills, by which it is pulverized. The pulverized fuel is distributed to the stone dryers, to the kilns, and to the coal dryers by a Fuller-Kinyon system.[17] A washer efficiently removes coal dust from the coal department.

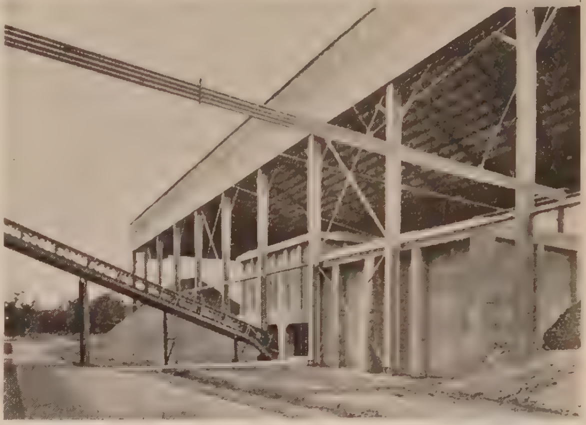
CEMENT BURNING

Individual fans supply air for the coal at the firing end of the kiln, the coal feed of each mill being controlled by the burner in charge. Clinker is burned in three Vulcan kilns,[14] 10 ft. in diameter and 150 ft. long, each being driven by a 50 h. p. direct-current motor, through a Link-Belt silent chain drive. A chain and sprocket, driven by the kiln motor, regulates the feed in accordance with the speed of the kiln.

Clinker is discharged by the kilns, which have a pitch of ⅜ in. per ft., onto a drag conveyor, by which it is discharged to a pit inside the crane runway. One of the two identical Champion 8-ton cranes, used in handling raw material and clinker, picks up the clinker and deposits it in clinker storage for future use, or if the clinker is to be used immediately, it is deposited by the crane into a hopper 15 ft. square, from which it is conveyed to the mill room.

Immediately before being conveyed to the finish grinding equipment on an inclined 24-in. pan conveyor, the clinker is weighed by a Merrick weightometer,[18] thus keeping an accurate record of the clinker ground. As the clinker passes the Merrick weightometer, the proper percentage of gypsum as predetermined is added automatically by an ingenious arrangement de-





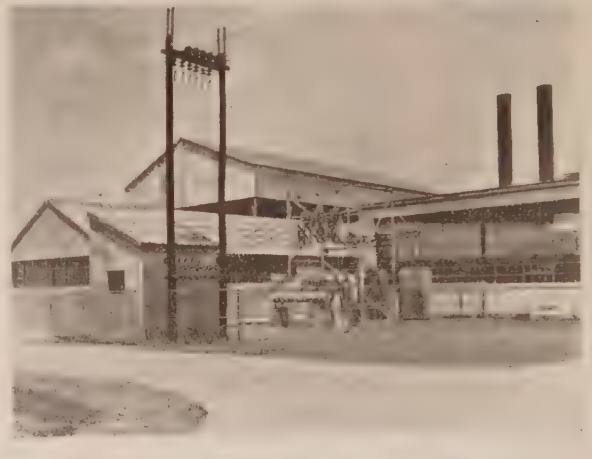


FIG. 5—VIEW OF WEST END OF DRYER ROOM, SHOWING SETTING CHAMBERS FOR DRYERS

FIG. 6—CONCRETE SHALE AND MIX BINS WITH PAN CONVEYOR TO DRYER ROOM

FIG. 7—TRANSFORMER YARD WITH VIEW OF STORE ROOMS

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[16] Cutler-Hammer Co., Milwaukee, Wis.

[17] Fuller-Lehigh Co., Fullerton, Pa.

[18] Merrick Scale Mfg. Co., Passaic, N. J.

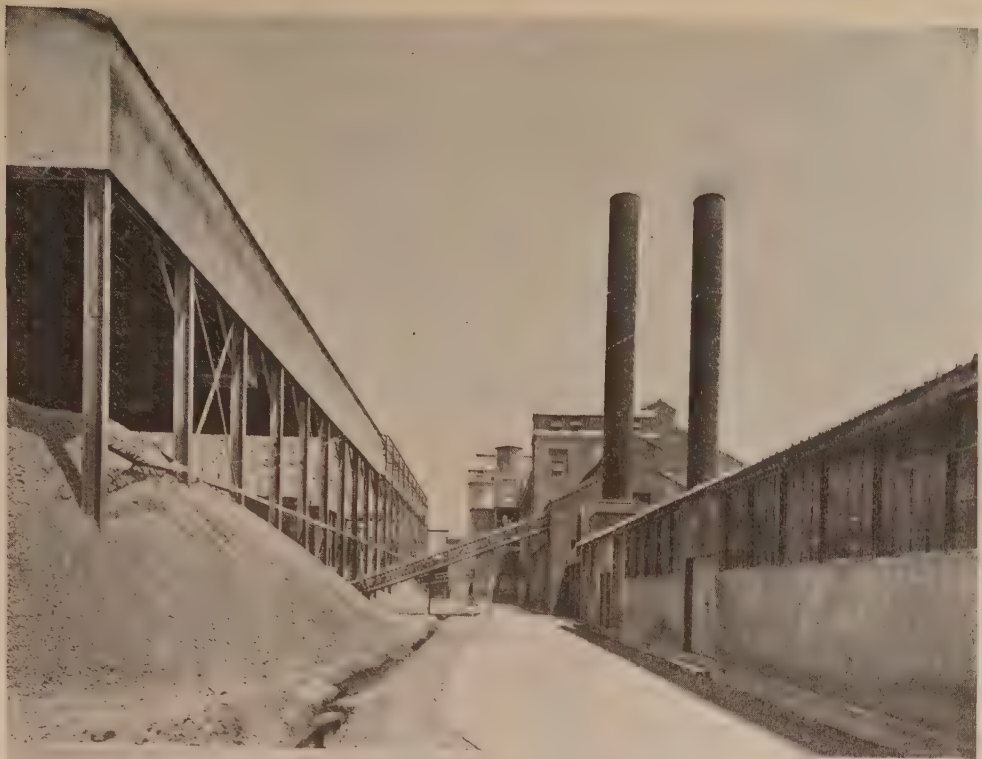

Fig. 8 — View from West End of Plant —Stone Storage on Left—Mill Buildings on Right

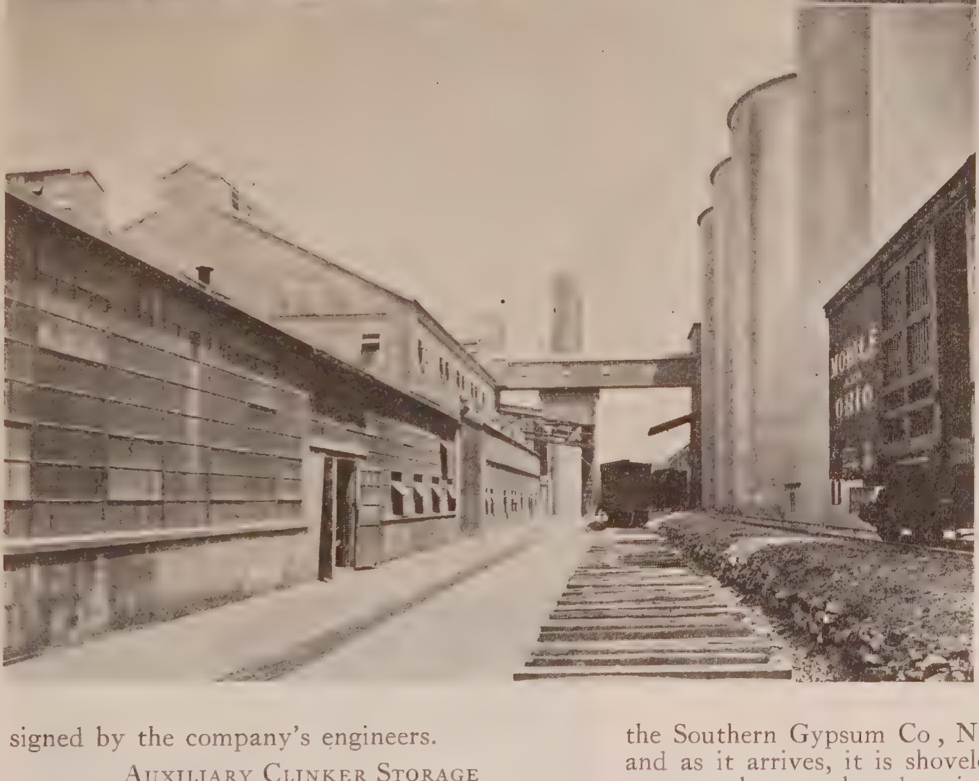

Fig. 9—Looking East from West End of Plant

signed by the company's engineers.

Auxiliary Clinker Storage

An auxiliary clinker storage is equipped with an electric locomotive crane, which runs on a 16-ft. gauge track and operates a 2½-yd. bucket on an 85-ft. boom, manufactured by Orten & Steinbrenner Co.[21] This crane picks up the clinker as it is deposited in the regular storage and dumps it in the auxiliary storage, reclaiming it again and placing it in the regular storage or in the clinker hopper over the weightometers as required. The auxiliary clinker storage gives a total capacity of 300,000 bbls. clinker storage.

Gypsum is shipped to the site of the plant from the Southern Gypsum Co , North Holston, Va., and as it arrives, it is shoveled out of the cars onto an elevator that deposits it in the gypsum storage, a reinforced concrete silo with an inside diameter of 20 ft. and a height of 42 ft.

Clinker and gypsum from the automatic weighing equipment, when the mixture reaches the mill room, is handled in a manner similar to that described for the raw material and is ground in similar equipment, going first to the Bradley-Hercules mill and then to the tube mill, as described, for finish grinding. From the tube mills, the finished cement passes through two screw conveyors and two elevators to the battery of reinforced concrete silos for bulk storage. There are twelve reinforced concrete silos, each with in-

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[21] Orton & Steinbrenner Co., Chicago, Ill.

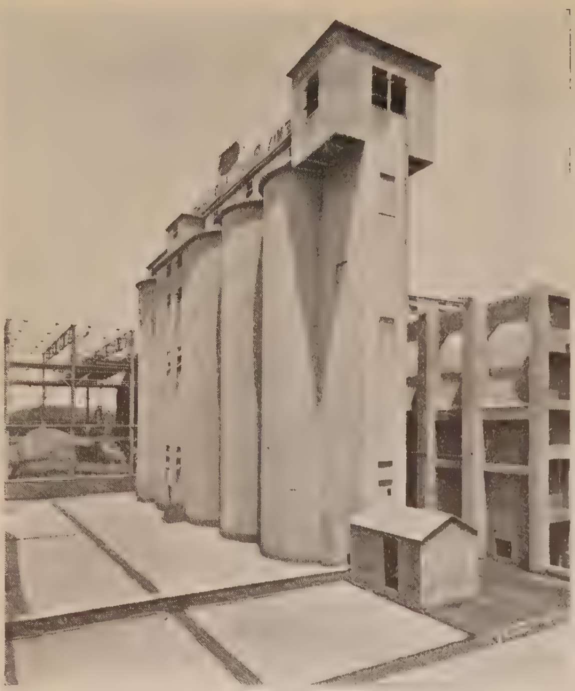


Fig. 10—Raw Material Storage Silos with Kiln Dust-Settling Chambers on Right

side diameter of 32 ft. and a height of 84 ft., divided into two units of six silos each; the first unit was built by the MacDonald Engineering Co., Chicago, Ill., and the second unit was built by the Burrell Engineering & Construction Co., Chicago, Ill. The cement storage capacity, including the interspace bins, is from 200,000 to 210,000 bbls. Spacious tunnels are provided under the silos, through which the cement is reclaimed by two lines of 16-in. screw conveyors, to which the cement is chuted through openings in the bottoms of the bins.

Pack House

There are four Bates 3-bag packers,[19] two for each side, from which the filled cement sacks drop to conveyors leading to cars on the adjacent tracks. In hot weather, a large electric fan is operated at the end of each conveyor to cool the men employed in loading cars. Bags are supplied in bundles from the bag house, which immediately adjoins the packing department, on an elevator built for that particular purpose. Sly dust collectors[20] in the bag room collect the cement dust from the packers and return it through screw conveyor to the hopper of the bagging machine.

The kiln stacks[21] are of reinforced concrete, 102 ft. high and 8 ft. in diameter at the top, built by the Webber Chimney Co., Chicago. An important and economical arrangement for the prevention of dust escaping from the plant has been made by the construction of a reinforced concrete dust-settling chamber, 72 ft. x 70 ft. and 45 ft. high, at the feed end of each kiln. These chambers are lined with firebrick, and are divided by baffles into hopper bottom compartments from which the reclaimed dust is conveyed through screw conveyors back to the raw silos. These kiln dust chambers were designed and built by the Rust Engineering Co., Birmingham, Ala.

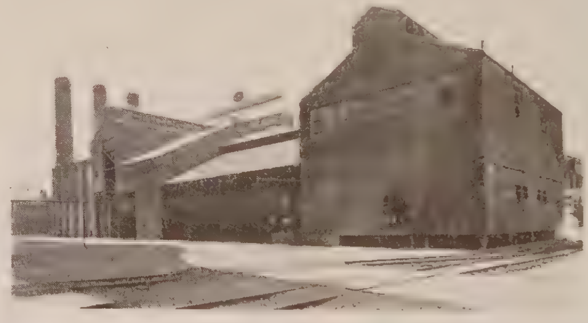
Some of the equipment not specially mentioned includes General Electric motors operating on Link-Belt silent chain drives on the kiln and rock and coal dryers, and on the elevating and conveying equipment. A 15-ton Orton & Steinbrenner caterpillar crane,[21] shown in the foreground of the general panoramic view of the plant, is put to general use throughout the plant yard and particularly in handling coal. An Ingersoll-Rand air compressor, having a capacity of 620 cu. ft., supplies air regularly for the quarry, for pumping and for the slurry agitation.

Power

Electric power to operate the entire plant and quarry is purchased from the Sloss-Sheffield Steel and Iron Co., whose property the Phoenix plant adjoins. As the company sells the excess power made from waste gases by by-product coke ovens, the cement company is assured a continuous supply of power.

Power is stepped down from 6600 volts to 2300 volts for the large motors and to 440 volts for the balance of the motors. Direct current to operate the kiln motors, magnetic clutches, and the electric cranes is produced by one of two General Electric rotary convertors, shown in the switchboard room. The second unit is held in reserve for use in case of emergency.

The main water supply is obtained from the city water system of Birmingham.



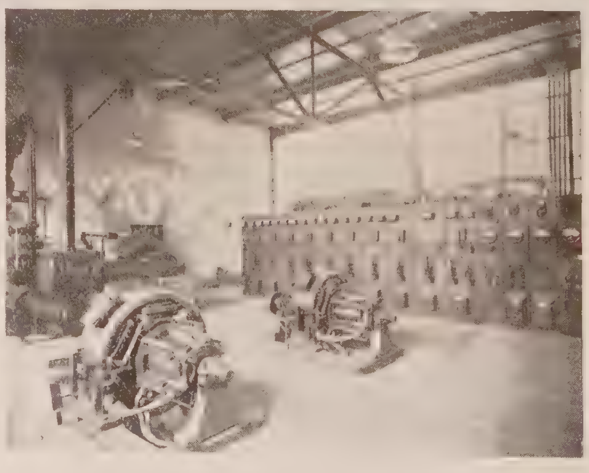


Fig. 11—View of Kiln Building from Northeast

Fig. 12—Cement Mill Power Room with Self-Starting Synchronous Motor Direct Connected to Air Compressor

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[19] Bates Valve Bag Co., Chicago, Ill.

[20] W. W. Sly Mfg. Co., Cleveland, Ohio

[21] Webber Chimney Co., Chicago, Ill.

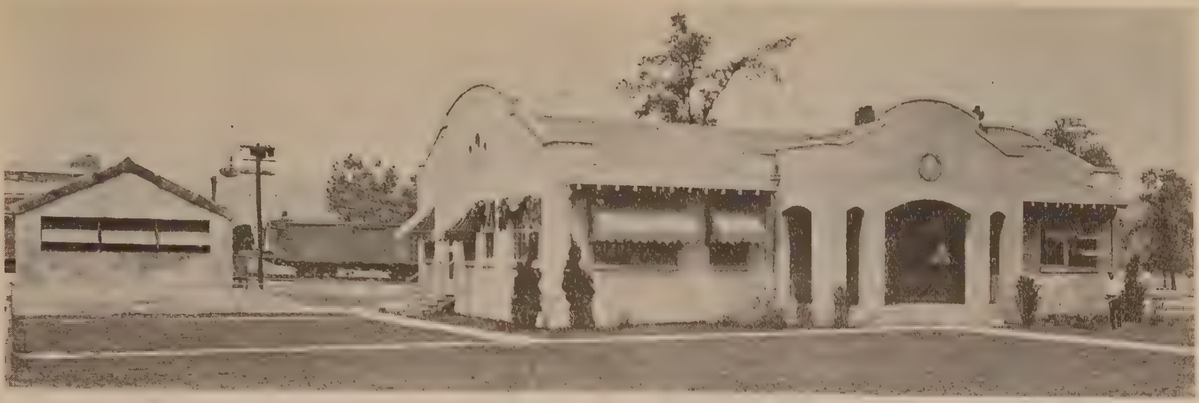

Fig. 13—Office and Garage at Left

Buildings

The buildings, including the clinker plant, coal mill, kiln building, dryer building, crane runway, and bag house, are steel framed structures covered with Gunite sidewalls[22] and reinforced concrete tile roof. The frames of these buildings were erected following usual methods, except that the girths were spaced further apart than for a covering of corrugated siding. The girths were, for the most part, 5-in. channels, punched every 18 in. with $\frac{9}{16}$ in. holes in their outer flanges. To these outer flanges ¼-in. rods were bolted, and a layer of electrically welded galvanized wire mesh was fastened. The mesh was made up of No. 12 gauge wire, spaced 2 in. apart in each direction. A wooden removable form was placed ½ in. inside the wire, and against this the Gunite was shot until a uniform thickness of 1¼ in. was built up. The mottled gray color of the Gunite walls contrasting with the red tile roof gives the entire group of buildings an exceedingly pleasing appearance, in addition to their permanence.

There are many noteworthy features about the plant. In fact, the entire arrangement has been worked out to obtain a maximum efficiency with a minimum of labor, and the selection of the most outstanding features must depend largely upon the point of view.

The machine shop and forge shop, with lineshaft drive for the various machines, are equipped to handle any emergency job, and an auxiliary Ingersoll-Rand air compressor is installed in the machine shop. Wash rooms and change houses for the employes are equipped with showers and lockers. A Bradley wash fountain,[23] made and installed by the Bradley Fountain Co., Milwaukee, Wis., is one of the conveniences unusual to a cement plant. This has proved not only convenient and sanitary for the men, but also economical in the use of hot water.

The oil room is equipped with a Bowser system[24] for handling all oil. Supplies of oil are delivered at the oil room by truck.

The company has a very conveniently arranged office building of pleasing appearance in harmony with the other buildings, as will be seen in one of the illustrations. The superintendent's office and chemical and physical laboratories are located in the building. In the superintendent's office an automatic electrically operated recorder[18] connecting with the plant records the number of barrels of clinker ground and the number of revolutions of each kiln. A separate laboratory is provided in the new storeroom, where Government and other foreign tests are made, thus keeping these activities entirely apart from the company's activities. An unusual piece of laboratory equipment for the cement mill field has been installed for testing concrete cylinders. It consists of a motor-driven Riehle compression testing machine,[25] with a capacity of 200,000 lb., manufactured by Riehle Brothers Testing Machine Co., Philadelphia, Pa.

The Birmingham plant is the Phoenix company's No. 2 plant, the original Phoenix mill being located at Nazareth, Pa., in the Lehigh Valley cement region, and has a capacity of 1,000,000 bbls. annually. Lindley C. Morton is president, and E. P. Haubert is secretary and also purchasing agent. Construction of the new plant under R. J. Hawn, superintendent, was carried out in record time, as evidenced by the fact that ground was first broken on September 28, 1922, and the first clinker produced on April 28, 1923. The first cement shipment was made on June 1, 1923, and the plant is now producing at the rate of 4200 bbls. of Phoenix cement daily. The other officers of the company are, J. W. Walker, vice president; A. W. Nash, Jr., treasurer; S. C. McCurdy, sales manager, Birmingham; Charles H. Cox, sales manager, Philadelphia; H. H. Leh, superintendent, Nazareth; and R. E. Roscoe, supervising chemist.

The portland cement industry in the South continues to show growth. The destruction of the plant of the National Cement Co. at Ragland, is regrettable. The plant is being rebuilt, engineers being at work on plans, and construction contracts are being let right along. Big plants in operation in the district, including the Phoenix, Atlas, and Lehigh Portland Cement Companies are producing on a large scale and shipping their product nearly as rapidly as it is being manufactured. Cement plants of the Birmingham, Ala., district have recently received a number of good sized orders for cement from the federal government, for work on Wilson Dam at Muscle Shoals.

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[22] Cement Gun Construction Co., Chicago, Ill.

[23] Bradley Fountain Co., Milwaukee, Wis.

[24] S. F. Bowser & Co., Fort Wayne, Ind.

[25] Riehle Bros., Philadelphia, Pa.

Pittsburgh Plate Glass Company Operates New Cement Plant

With comparatively few exceptions, American portland cement mills are operated by companies organized primarily to engage in cement manufacture. Waste-products and by-products are not important factors with the majority of companies. One more exception has been made by the Pittsburgh Plate Glass Co. in the construction and operation of a wet process cement plant at Fultonham, near Zanesville, Ohio. The reason given by the company for entering the cement manufacturing field was the desire to find a profitable use for limestone screenings from the crushing plant at Fultonham, waste materials which it was once planned to use in the manufacture of agricultural limestone. This so-called waste stone when converted into portland cement has found a very ready market, particularly in Ohio where the company has the advantage of a short freight rate.

A crushing plant which was built in 1920 to supply the limestone requirements of the company's plant at Bamberton, Ohio, for the manufacture of soda ash used in the manufacture of glass, has a daily capacity of 3000 tons. Forty per cent of this rock remains after the material from 4 to 8 in. in size has been removed for use in the chemical plant. Material under 4 in. is recrushed for the production of concrete aggregate and the daily output of from 500 to 600 tons of fines ranging from ¾ in. to dust results. This fine material resulting from the primary and secondary crushing and screening of the rock is the material formerly considered as waste and now used in making cement. Before entering the cement manufacturing field, investigations were made which proved that in addition to the limestone, which is a very high grade, running 93 to 95% calcium with 3 to 4% of silica and less than 2% magnesia, the company's properties contained extensive shale deposits 40 ft. and 100 ft. deep of the proper composition for cement raw material. Following favorable reports of analyses made in the laboratories of F. L. Smidth & Co. and the Pittsburgh Testing Laboratories, it was decided to go ahead with the construction of the plant on April 1, 1923. Plant operation was started July 15, 1924.

The cement manufactured is sold under the brand name, Columbia.

Plant Layout

As will be seen by reference to the general layout plan of the plant, the main departments are arranged in a straight line from the raw mill to the clinker storage and clinker grinding mill, all of these departments being housed in one building 50 ft. wide and 724 ft. long. The cement plant is located to the south of the stone crusher and although the crushed rock enters the raw mill at the south end, the whole layout has the appearance of a continuous straight chain of operations. The design of the plant embodies many of the latest improvements in modern plants inspected by officials of the company during a visit made for the purpose of compiling data.

Coal

In addition to the limestone and shale so readily obtainable, coal for burning is also available and is brought to the plant on a switching charge from two veins in close proximity to the plant. Coal from one source is received over the company's tracks connecting the plant with the newly opened quarry about one-half mile away on Buckeye creek.

The raw materials—limestone and shale—are both brought in standard gauge cars to the crusher building on the hillside to the west of the main plant. Limestone is deposited into a bin and fed by an apron conveyor into an elevator, thence to a 500-ton stone bin. The shale is crushed to 1 in. and smaller in a Pennsylvania swing hammer mill[1] fed by an apron conveyor from a 300-ton concrete bin. It then passes to a shale bin adjacent to the stone bin, with a capacity of 500 tons. Shale and stone are fed in the proper proportions from these adjacent bins by a double automatic apron conveyor to a 24-in. Robins belt conveyor[2] operating on 300-ft. centers between the crusher building and the steel storage bins. These bins each have a

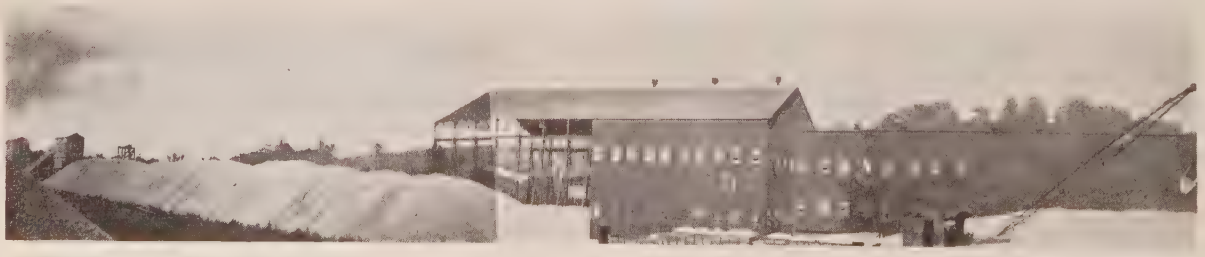

Fig. 1—Panoramic of Pittsburgh Plate Glass Co.'s Portland Cement Plant

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[1] Pennsylvania Crusher Co., Philadelphia, Pa.

[2] Robins Conveying Co., New York City.

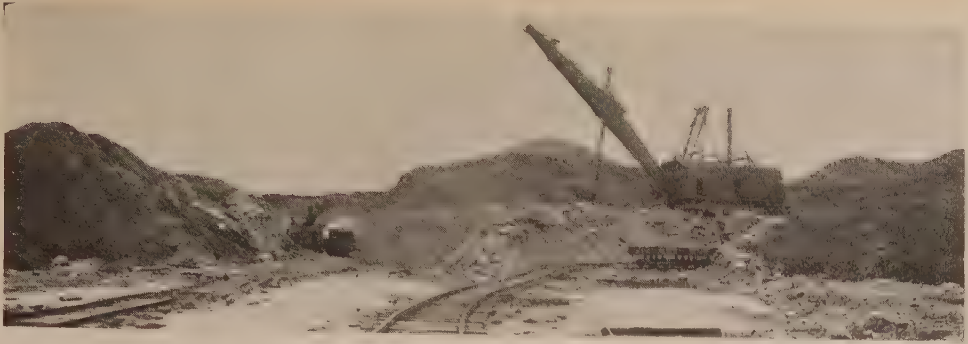


Fig. 2—View in Quarry Showing Large No. 300 Marion Stripping Shovel, Which Strips and Deposits the Stripping Back Into the Quarry from Where the Stone Has Been Removed

capacity of 500 tons from which the mixed raw material is fed automatically to the raw grinding compeb mills.

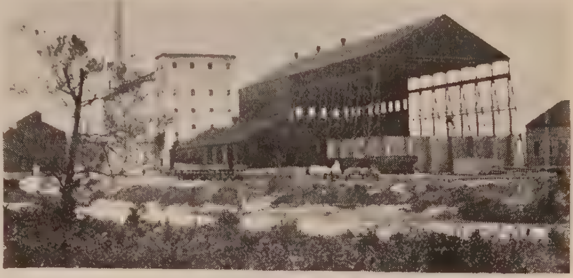
In the raw mill, the proper proportion of water is added to the raw mix and the material ground to a slurry of the required fineness in two Allis-Chalmers compeb mills,[3] 7 ft. in diameter by 26 ft. and driven by 500 h. p. synchronous motors operating at 2200 volts through Cutler-Hammer magnetic clutches.[4] From the raw grinding compeb, the slurry passes to Allis-Chalmers automatic air lift pumps[3] which force it into the correcting tanks.

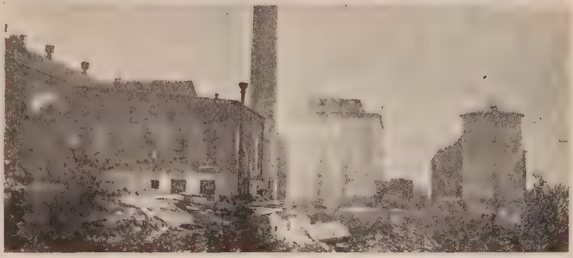
Eight circular reinforced concrete correcting tanks are provided and from these, the chemists' samples are taken for analysis. The tanks are agitated by air through openings at the bottom to prevent the slurry from separating. Following the analysis, any necessary corrections in the mix are made by adding lime or shale as required. A set of air lift pumps forces the properly mixed slurry to the two concrete feed tanks, one of which is located under each kiln. Automatic feeders connected with plunger pumps,[5] both of F. L. Smidth make, feed the slurry to the kilns as required.

Coal Department

The coal used for firing the kilns when brought in from the mines, as previously mentioned, is dumped from the cars into the coal track hopper and conveyed to the coal grinding equipment consisting of two 42-in. Fuller Lehigh mills.[6] The coal mill building is 45 ft. x 118 ft. and parallel to the coal tracks. Pulverized coal is transported by a Fuller-Kinyon pump[6] through a 5-in. coal transport line from the coal mill to the coal feed bins in front of the firing end of the kilns. These pulverized coal bins are equipped with electrically operated automatic controlling devices which indicate the amount of coal in the bins.

Two Worthington kilns[7] are in operation, each 10 ft. x 165 ft. lined for 40 ft. in the burning zone with 9-in. fire brick and the remainder of the length with 6-in. brick, all insulated with 3-in. Sil-O-Cel[8] brick. The kilns are driven by 50 h. p. variable speed motors. The feed end of





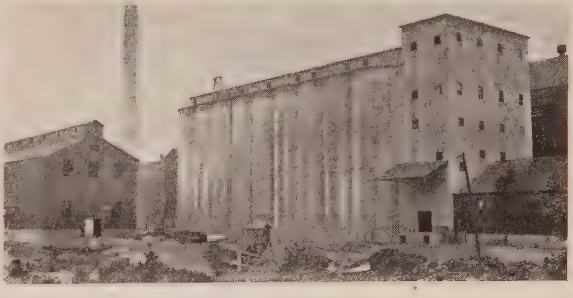
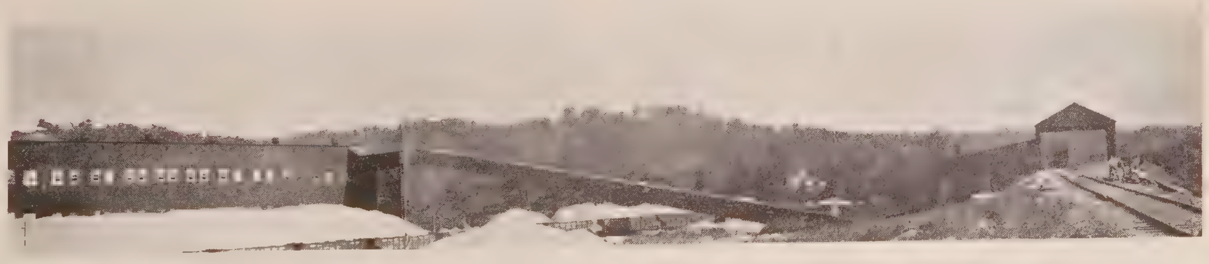


Fig. 3—View of Finishing Mill, Clinker Storage, and Packing Room, Looking South

Fig. 4—Power House and Raw Grinding Department on Left. Concrete Stack 16 Ft. Diameter, 205 Ft. High

Fig. 5—View of Packing Storage Bins and Coal Mill, Looking from East to West



Showing the Straight Line Arrangement of Main Buildings

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[3] Allis-Chalmers Mfg. Co., Milwaukee, Wis.

[4] Cutler-Hammer Mfg. Co., Milwaukee, Wis.

[5] F. L. Smidth Co., New York City.

[6] Fuller-Lehigh Co., Fullerton, Pa.

[7] Worthington Pump & Machinery Co., New York City.

[8] Celite Products Co., New York City.

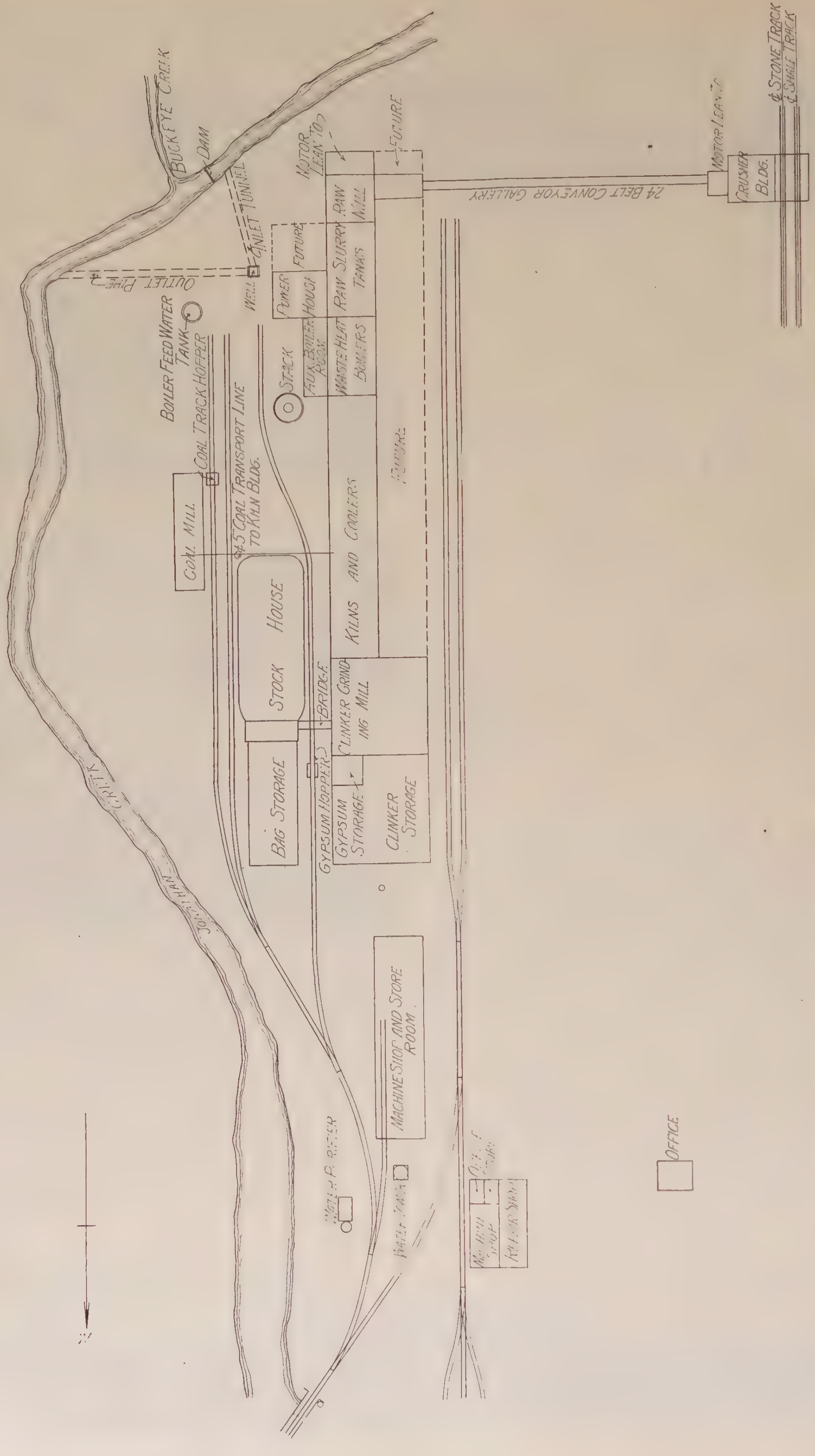

FIG. 8—GENERAL LAYOUT OF PORTLAND CEMENT PLANT OF PITTSBURGH PLATE GLASS CO.

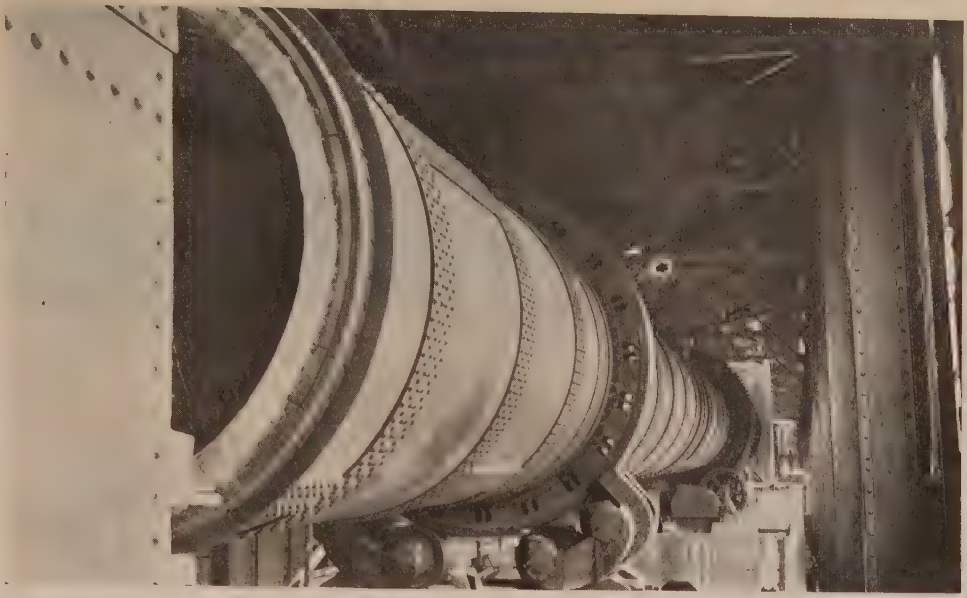

FIG. 6—ONE OF THE KILNS INSTALLED. IT IS 10 FT. IN DIAMETER AND 165 FT. LONG

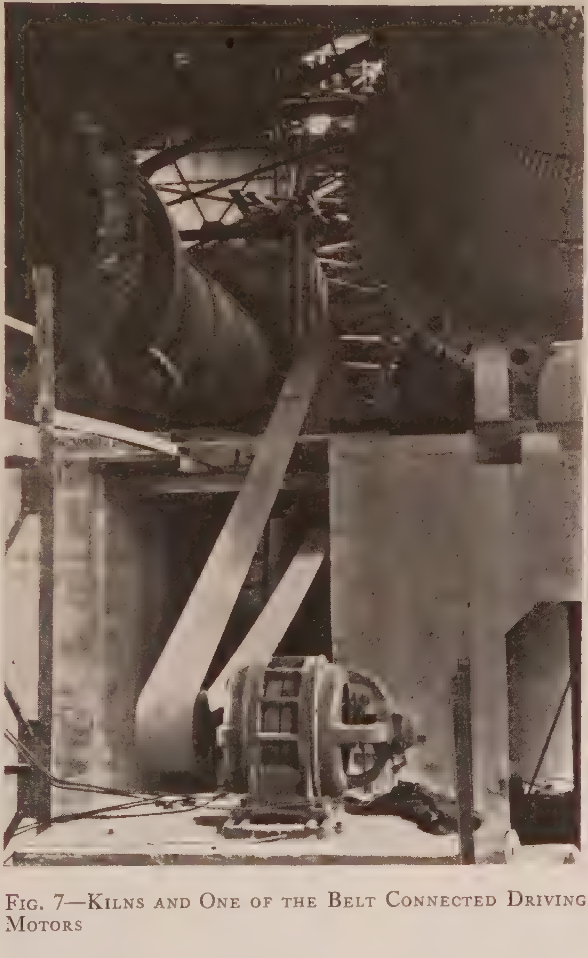

FIG. 7—KILNS AND ONE OF THE BELT CONNECTED DRIVING MOTORS

each kiln has a baffle ring made up of larger size brick in the end row which prevents the slurry from backing up as it is fed to the kiln. A Brown automatic recording device[9] records the kiln temperature. The kiln motors are belt connected and operate on 440 volts.

Hot gases from the kilns are discharged through waste heat boilers which provide power to operate the various departments of the plant. An 8-ft. x 80-ft. Worthington cooler[7] receives the clinker as it is discharged from each kiln. These coolers are of natural draft type lined throughout the first 15 ft. with hard fire clay block and for the remainder of their length with cast iron wearing plates separated from the cooler shell by a 1-in. air space.

From the coolers, clinker is discharged onto one of two belts and elevated to the steel feed bins over the two finish grinding compeb mills. These compebs are similar to the raw grinding equipment and have similar drives. As the clinker discharges into the compebs through automatic feeders, the required gypsum is added to regulate the setting properties of the finished cement. A clinker storage having a capacity of 44,000 bbls. of clinker adjoins the clinker grinding mill as shown in the general plan. The clinker storage is part of the main building and is lined with concrete. A 7-ton Alliance electric traveling crane[10] with a 97-ft. span picks up the clinker in a 3½ yd. bucket and distributes it throughout the storage, reclaiming clinker again and discharging it into the bins over the finish grinding compebs. Clinker can be put into storage in case of accident to either of the elevators to the compeb bins or in case the compebs are shut down, thus keeping the kilns in continuous operation.

Gypsum is shipped to the plant and stored in the gypsum storage provided in one corner of the clinker storage department and served by the same crane as used for handling clinker. It is unloaded by dumping into a gypsum hopper alongside the clinker storage. From the finish grinding compeb mills, cement is elevated to a conveyor which transports it across an overhead bridge into storage or to bins over the packers if it is to be used for immediate shipment.

The silo storage consists of 10 concrete silos, each 33 ft. in diameter and 65 ft. high, giving a combined capacity with the wing and diamond bins of 160,000 bbls. The cement silo storage building and clinker storage were built by the Spencer Construction Co. Beneath the silos are four tunnels each giving access to a 16-in. screw conveyor fed from the bottom of the bins by one of two F. L. Smidth exbiners.[5] Bags are cleaned, sorted and repaired in a steel storage building immediately adjacent to the packing room. The bags are conveyed to the two 4-tube Bates valve bagging machines[11] and filled with cement and the filled bags are finally conveyed to the cars to be loaded for shipment.

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[9] Brown Instrument Co., Philadelphia, Pa.

[10] Alliance Machine Co., Alliance, Ohio.

POWER

As stated previously, power to operate the cement plant and the crushing plant is furnished by two Edge Moor waste heat boilers[12] 800 h. p. each, installed behind the kilns. The power house equipment includes two Allis-Chalmers turbines and generators[3] rated at 1250 k.w. at 3600 r.p.m. and 80% power factor. This rating is increased by the synchronous motors to about 1550 k.w. Wheeler surface condensors[13] for the turbines are supplied with water from Johnathan creek which has been dammed to a head of 5 ft. on the company's property, where a tunnel conducts the water to the cold well near the power house, as marked on the general plan.

In the auxiliary boiler room adjoining the waste heat boiler installation, a 400 h. p. coal fired boiler[12] is kept in reserve as a spare unit and used in starting the kilns. After the kilns are put in operation this boiler is shut down. The boilers operate at 175 lbs. pressure and 200° superheat being fitted with Green fuel economizers[14] and Foster superheaters.[15] The condensers, boiler feed pumps and service pumps, three transformers of 250 k.v.a. capacity each for stepping down the current from 2200 volts to 440 volts and two Ingersoll-Rand air compressors[16] of 350 cu. ft. capacity each are all located in the basement of the engine room. A reinforced concrete stack[17] 200 ft. high built by the Heine Chimney Co. is located adjacent to the auxiliary boiler room.

With the exception of the 100 h. p. motors driving the fans back of the waste heat boilers and the 500 h. p. compeb motors which operate at 2200 volts, motors throughout the plant operate at 440 volts. The motors[18] are General Electric equipment except one 50 h. p. variable speed slip ring motor[19] of Fairbanks Morse make, used to turn one kiln.

Interesting features about the plant are evident throughout the entire course from the raw material to the final step in the finishing and shipping. The long distance traversed in a straight line, in one direction and under one roof, has proved for efficiency and permitted a layout with a minimum amount of conveying and elevating.

The buildings are of concrete and steel frame, the main building being covered by Robertson patent corrugated steel and asbestos roofing.[20] The machine shop, storage room and office building are of brick construction. The machine shop and supply storage room which are under the same roof are separated by the office of the stock keeper and small stores. This building is served by a railroad track which enteres the north end.

FIG. 9—OFFICE AND LABORATORY AT THE PLANT. TO THE RIGHT ARE SHOWN TWO OF THE HOUSES ERECTED BY THE COMPANY FOR ITS EMPLOYES

The laboratory and office building is a two-story and basement structure with brick walls and reinforced concrete beams and floors. The chemist's laboratory is laid out so as to insure a maximum of natural light from the outside and is well lighted artificially. The physical laboratory in the basement is fitted with all the modern laboratory equipment used in connection with the manufacture and testing of cement.

In the vicinity of the laboratory, the company has recently completed the erection of some small houses for the employes and more are under construction. They are fitted with all city conveniences such as electric lights, water, gas, and sewer connections. A large number of the employes are boarded at actual cost at a commissary maintained by the company, where about 200 meals a day are served.

The success of the cement plant of the Pittsburgh Plate Glass Co. is the result of the efforts of practical cement mill men connected with the project, among whom are: H. A. Henry, superintendent, who was in charge of design and construction; M. C. Foster, construction engineer; R. W. McAllister, chief engineer in charge of the power house; and A. E. Hiscox, chief chemist. Mr. Henry has had wide experience in the construction and operation of cement plants throughout the world including South Africa, Japan, and America during his connection with the Allis-Chalmers Mfg. Co. J. C. Buckbee & Co. were consulting engineers.

F. A. Jones, manager of the Columbia Chemical Division, Limestone Products Dept. who has had personal charge of the plant construction, was formerly manager of operations of the Kelley Island Lime and Transport Co. Mr. Jones designed and now operates the Pittsburgh Glass Co.'s original crushing plant at Fultonham. L. E. Smith is superintendent of the crushing department, N. Griffin is superintendent of the quarry and L. M. Aitkins is master mechanic.

In charge of the main office of the Pittsburgh Plate Glass Co. in the Frick Bldg., Pittsburgh, Pa., are: Charles W. Brown, president; W. L. Clause, chairman of the board; H. S. Wherett, vice president and Edwin Pitcairn, treasurer. H. A. Galt, vice president, is located at Bamberton, Ohio, and is general manager of the chemical plant at Bamberton and the limestone products department at Fultonham.

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[11] Bates Valve Bag Co., Chicago, Ill.
[12] Edge Moor Iron Co., Edge Moor, Dela.
[13] C. H. Wheeler Mfg. Co., Philadelphia, Pa.
[14] Green Fuel Economizer Co., Beacon, N. Y.
[15] Power Specialty Co., New York City.
[16] Ingersoll-Rand, New York City.
[17] The Heine Chimney Co., Chicago, Ill.
[18] General Electric Co., Schenectady, N. Y.
[19] Fairbanks-Morse Electrical Mfg. Co. Indianapolis, Ind.
[20] Asbestos Protected Metal Co., Beaver Falls, Pa.

The Öland Cement Company's Plant at Degerhamn, Sweden

By Dr. Frans Killig
Superintendent of the Plant

Owing to the inexhaustible deposits of both oil shale and limestone, the Isle of Öland, Sweden, has been the seat of industrial exploitation since olden times. The industries most nearly dependent on these raw materials developed rapidly, thanks to the favorable situation of the island, near the mainland of Sweden, and its many good and well-protected harbors. Lime kilns were established in many places on the 100-mile long island, but only a few of them are now in operation, and immense piles of shale ashes are about the only remains of these old industries. The lime and cement industry of Öland is now concentrated at the best and deepest harbor of the island, at Degerhamn.

The ancient industries carried on at Degerhamn—the alum and lime production, based on the oil shale and limestone resources—have been described in a previous issue.[1] The first works, Lover's Alum Works, was established as early as 1723, and Ölands Alum Works was started in 1803. Both of them were rather extensive enterprises, and employed, according to old statistics, about 400 persons.

These concerns, however, could not survive in the competition set up by new factories working in accordance with the methods of modern chemical science, and in the end had to shut down. They have since found a successor in a new industry of apparently unlimited opportunities for expansion, viz., the cement industry.

Öland's Cement A. B. was founded in 1886, being the second Swedish cement works to commence operations. At the end of last century, the manufacture of cement had not advanced very far, either in respect to the chemistry of the process or the mechanical methods of production. It was undoubtedly a rather daring undertaking to start a cement works at that time, and it is worth noting that one of the promoters, and the first chairman of the board, was a man who had shown courage and enterprise in another field, the celebrated Arctic explorer, Baron A. E. Nordenskiöld.

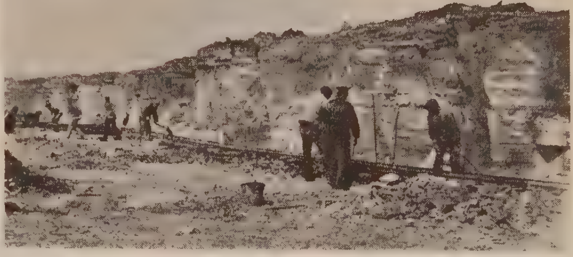


Fig. 2—Limestone Quarry

The Isle of Öland has the best imagniable conditions for carrying on a successful cement industry, viz., inexhaustible and easily accessible deposits of limestone belonging to the Silurian

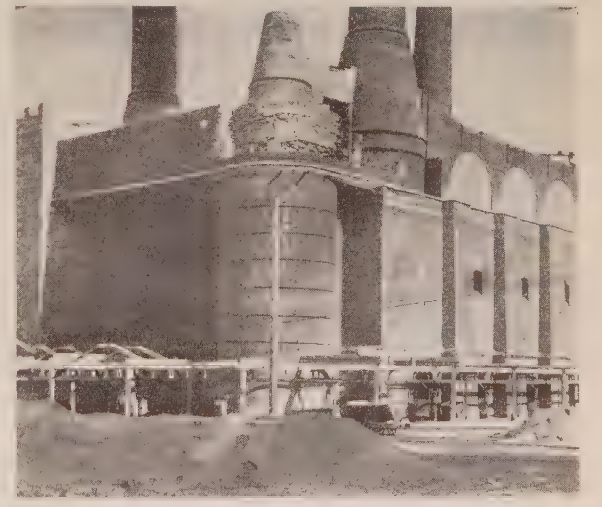
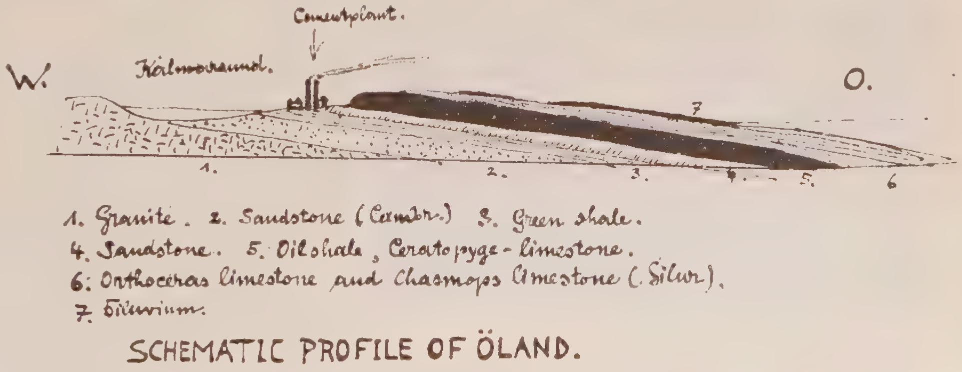


Fig. 3—Shaft Kilns Used in Old Cement Factory


Cementplant.
Kalmarsund.
W.
O.
7
1.
2.
3.
4.
5.
6
1. Granite. 2. Sandstone (Cambr.) 3. Green shale.
4. Sandstone. 5. Oilshale, Ceratopyge-limestone.
6: Orthoceras limestone and Chasmops limestone (Silur).
7. Diluvium.
SCHEMATIC PROFILE OF ÖLAND.
Fig. 1—Schematic Profile Showing Rock Formation

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[1] Cement Mill Section of *Concrete* January, 1924.

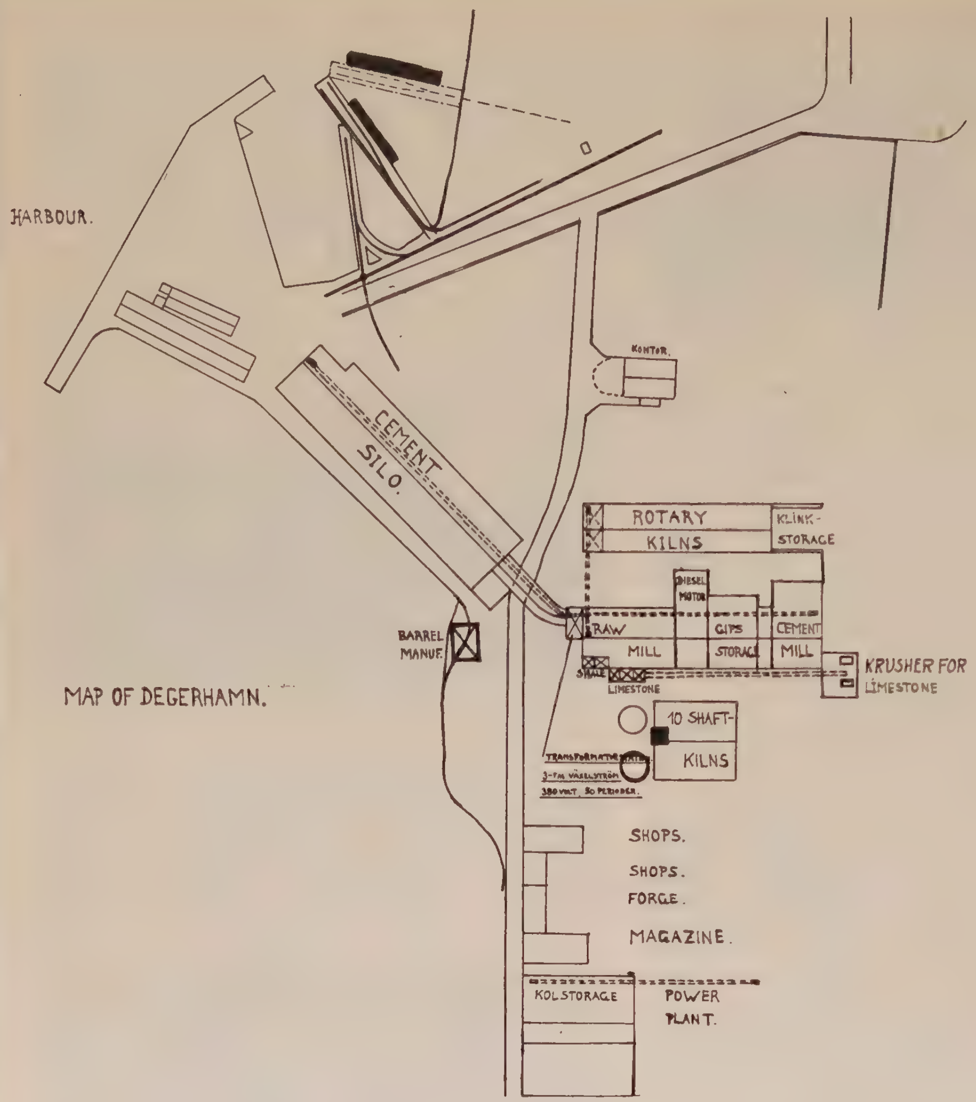


Fig. 4—Map of Degerhamn, Showing Layout of Works

system, which constitutes the chief mass of the narrow island. The geological profile, Fig. 1, shows the Cambric shales, and on top of them the Silurian limestone, the thickness of the layers increasing to the southeast, owing to the dip. In the company's quarries, the limestone layer is from 4 to 5 m. thick; the shale about 15 m. The limestone, shown in Fig. 2, occurs in layers and is easy to extract. It is conveyed from the quarry on a light-gauge railway down to the factory, which is on a lower level than the plateau.

The old cement factory, which was adapted for the dry process, consisted of a rather large mill plant for grinding the raw product and the cement, having 16 old-fashioned millstones. The limestone, which was quarried at the same place used at present, and the clay, which is not available on the island, but had to be brought from the mainland in small skiffs, were dried in chambers fired with oil shale. The dried mass was crushed and ground, and was then briquetted in 12 ordinary straight-shaft kilns, so-called Schneider kilns shown in Fig. 3.

The cement manufacturing was carried on for more than twenty years at Degerhamn according to this method, and the cement made there was of excellent quality, though the efficiency of the plant was not high and output of the old kilns

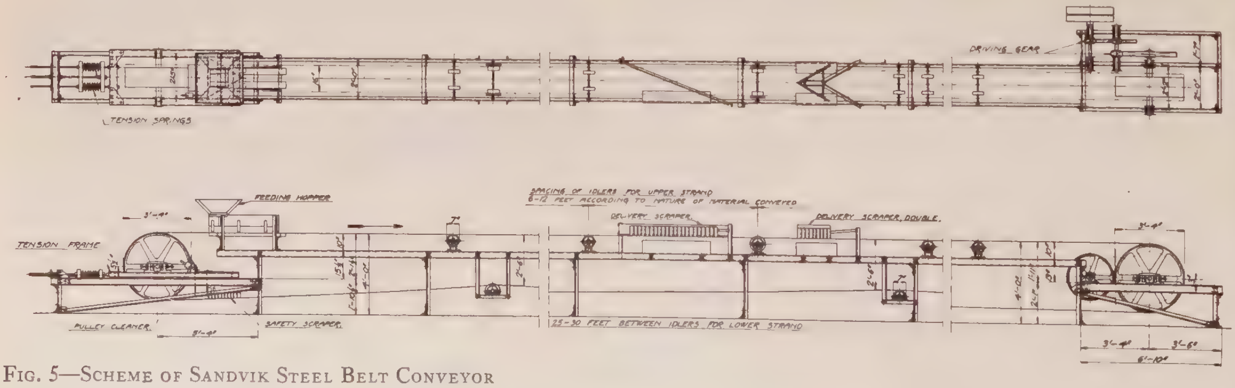

TENSION SPRINGS
DRIVING GEAR
FEEDING HOPPER
TENSION FRAME
SPACING OF IDLERS FOR UPPER STRAND
6-12 FEET ACCORDING TO NATURE OF MATERIAL CONVEYED
DELIVERY SCRAPER
DELIVERY SCRAPER, DOUBLE.
PULLEY CLEANER
SAFETY SCRAPER
25-30 FEET BETWEEN IDLERS FOR LOWER STRAND
3'-4"
3'-4"
3'-4"
3'-4"
3'-6"
6'-10"

Fig. 5—Scheme of Sandvik Steel Belt Conveyor

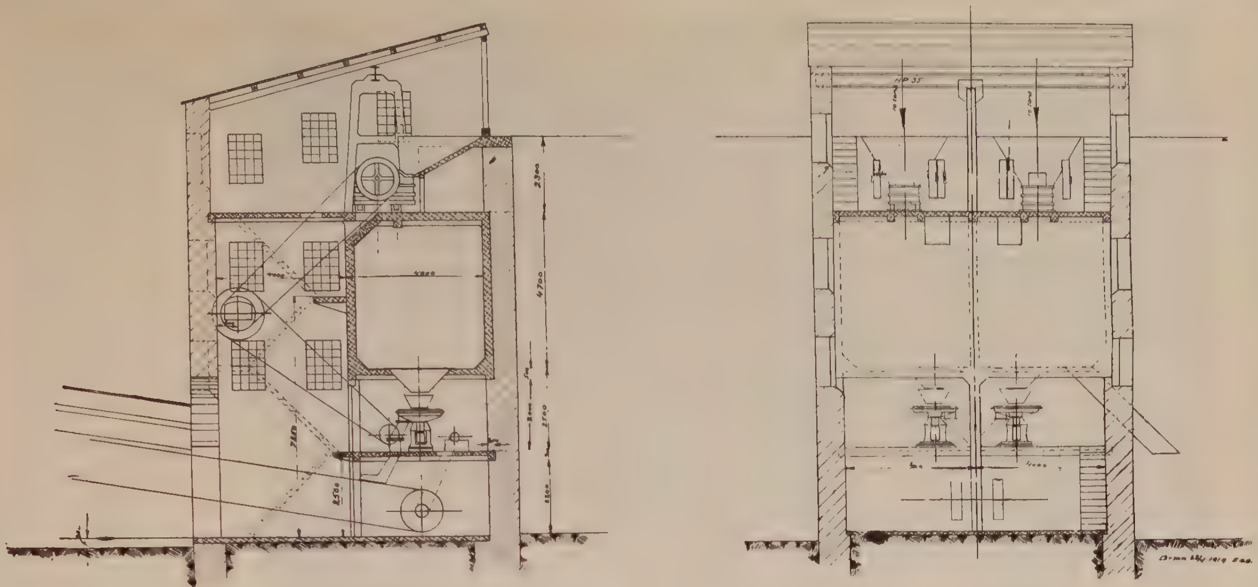


Fig. 6—Crushing Station, Hill Side Plant

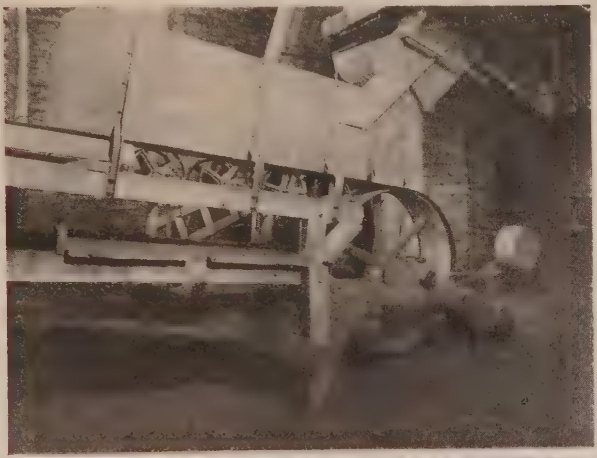


Fig. 9—Shale Ash Heaps

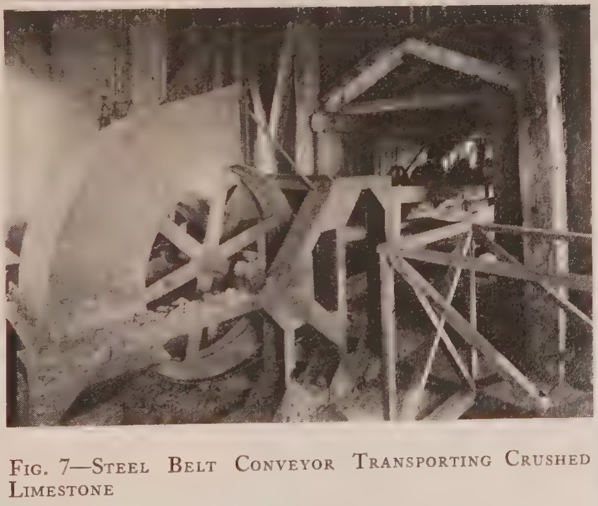


Fig. 7—Steel Belt Conveyor Transporting Crushed Limestone

Fig. 8—Steel Belt Conveyor for Cement

rather small. A great deal of manual work was also required, and all these circumstances together made it necessary to remodel the factory in conformity with modern methods.

After having previously replaced the old millstones with modern ball and tube mills, the first rotary kiln of 40 m. length was built in 1908. A few years later another rotary kiln on the F. L. Smidth-Copenhagen system was added.

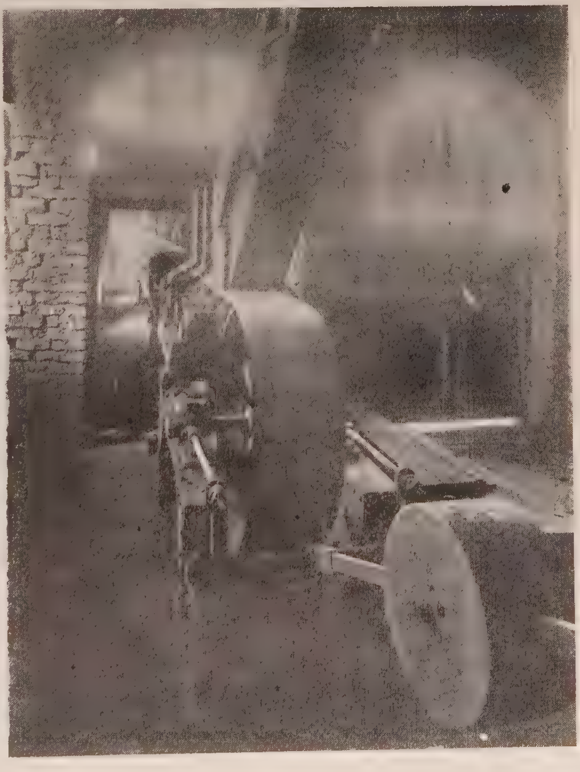


Fig. 10—Steel Belt Conveyor for Raw Cement

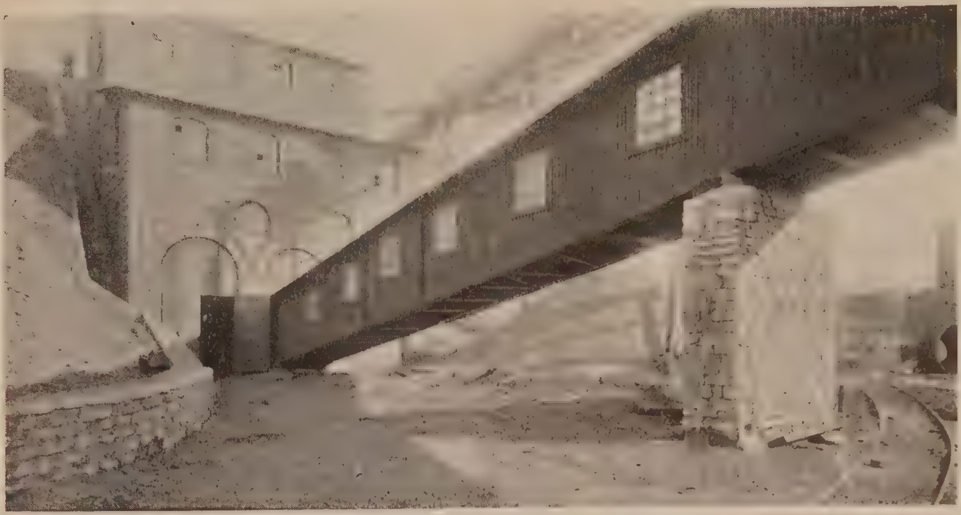


Fig 11—Limestone Crushing Plant

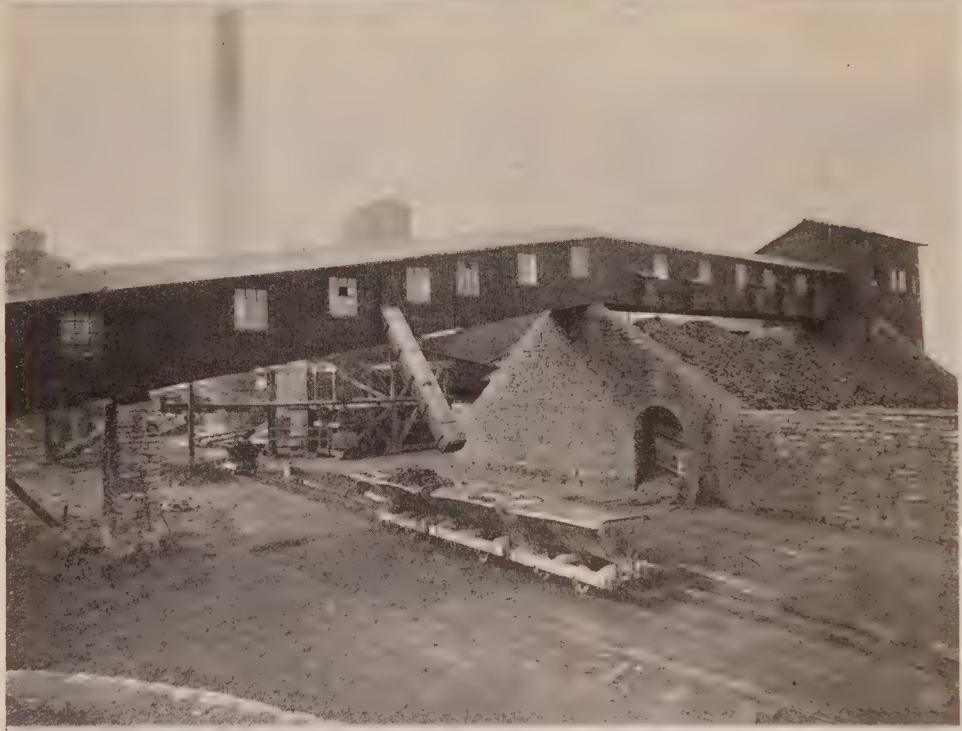


Fig. 12—Coal Storage

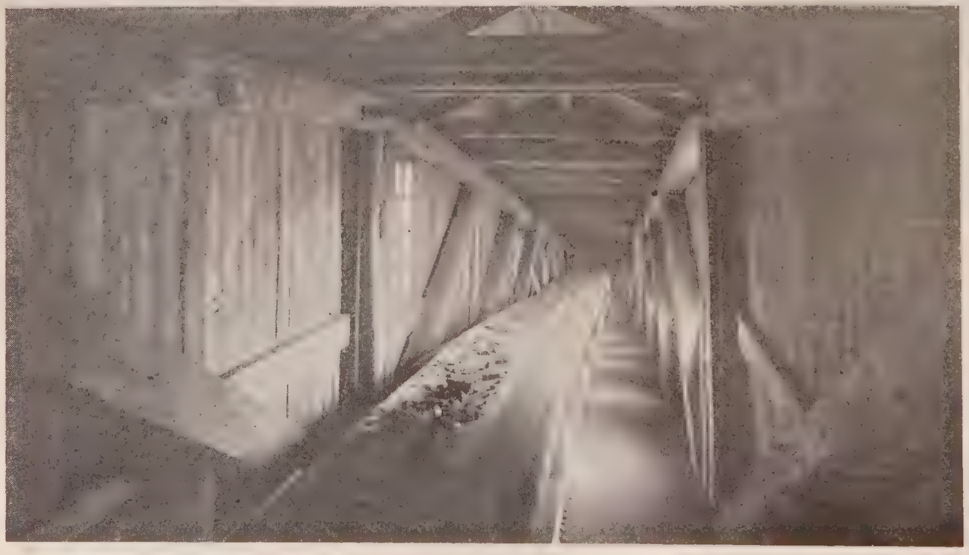


Fig. 13 — Steel Belt Conveyor for Conveying Coal at Power Plant

Fig. 14—Rotary Kilns

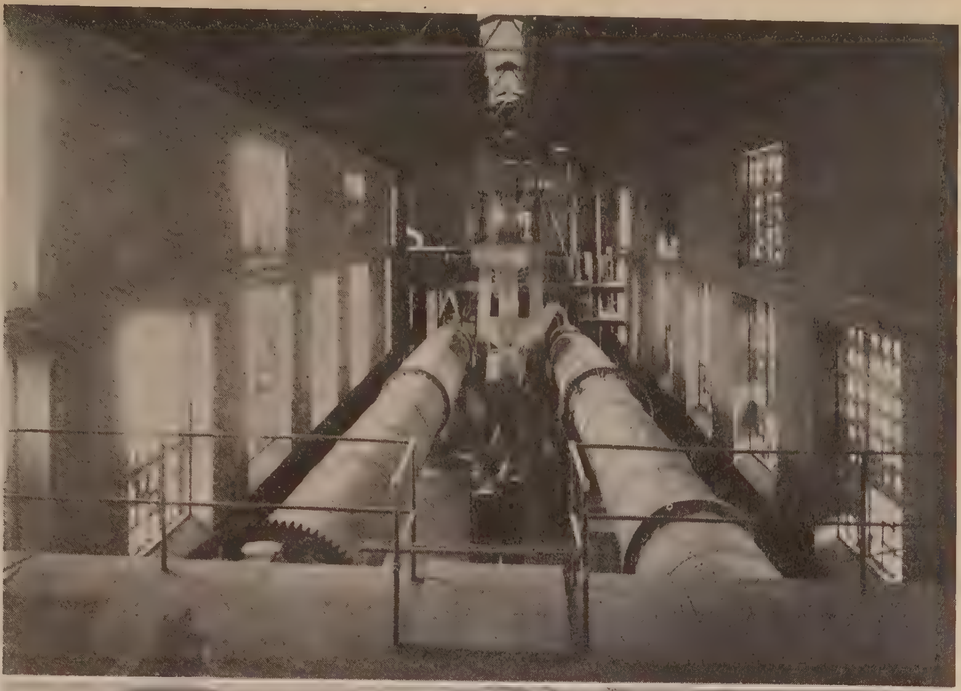
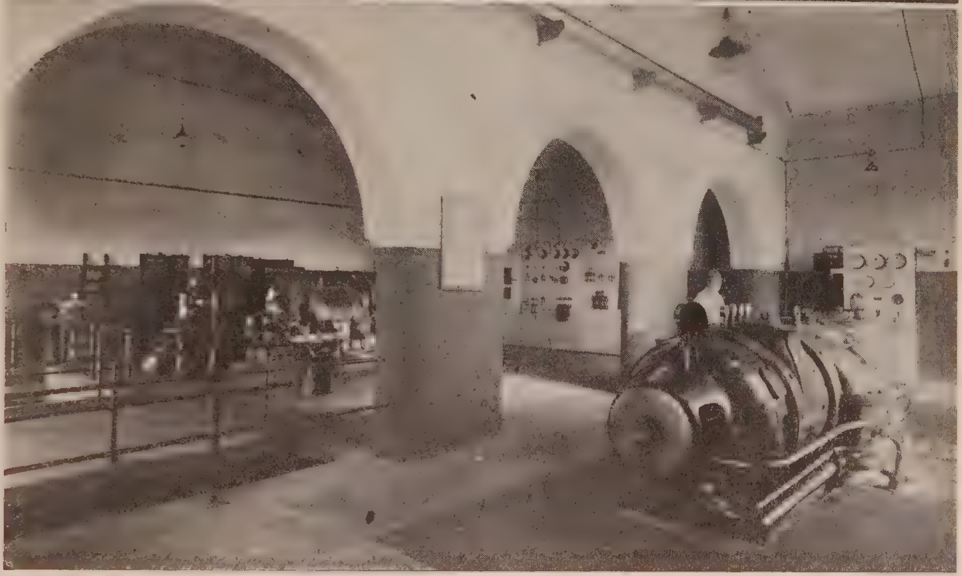


Fig. 15—Power Plant with 1000 k.w. Ljungstrom Steam Turbine



The production was in this way increased to 1000 bbls. per day. The old, tried, dry process was retained through all. Simultaneously with making these improvements, the old shaft kilns were adapted for lime-burning on a large scale, using oil shale for fuel.

It is to be noted that in the new factory all transportation of material takes place by means of Sandvik steel belt conveyors, which handle stone, coal, raw cement, and finished cement. None of the modern transporting devices, formerly used in our own factory and now used in other works, has proved as serviceable and as simple and reliable to operate as steel belt conveyors, beside which the consumption of power and wear is small.

On the accompanying plan of the factory, the steel belt conveyors are plotted, and it will be seen that the distances are great. Fig. 5 shows schematically the most common type of steel belt conveyor. The belt runs on iron rollers (idlers) and over a terminal drum or pulley of about 1 m. diameter at each end. One of these pulleys is equipped with a weight device for maintaining the proper tension, and the other acts as driving pulley in connection with a pinion and gear. The material to be conveyed is fed to the belt by means of automatic devices, and is discharged by means of a radius scraper plow with adjustable arms. The width of the belt is from 300 to 450 mm.

Raw Grinding

The limestone is conveyed from the quarry to a crushing plant by means of a light gauge railway, the plant in question being erected as a hill side plant Fig. 6. The stone is crushed there and stored in two magazines, each holding 60 cu. m., whence it is discharged by means of a rotary board and fed onto a steel conveyor belt Fig. 11, 450 mm. wide and 156 m. long. By this belt, the crushed stone is conveyed on an inclined plane up to a large stone storage silo, 11 m. high, with three compartments. The 11-meter rise is accomplished in a distance of only 55 m., and the belt conveys 10 to 15 tons of crushed stone per hour.

There are facilities for discharging the stone from the belt on the way and letting it pass through a drying drum. This arrangement is used only in winter.

In the old factory, clay was used as the other component of cement manufacturing. After the remodeling of the works, the clay has been replaced by shale ashes, as the new kilns do not require a raw product of plastic consistency. Shale ashes are available in immense quantities in the form of worthless waste from the lime-burning, which is carried on in the old shaft kilns side by side with the new plant. Strange to say, this shale ash is approximately of the same composition as the clay, and is, contrary to what is the case with the ash from British and German shale, free from dangerous or unsuitable components, such as S, SO^3, MgO, etc. It is also absolutely dry, easy to grind, and obtained free of cost. The lime-burning is also made cheaper, as the removal of the great quantities under consideration requires a suspension rope way to the dumping place quite a distance away, and is altogether quite a troublesome problem. The method of dumping the shale ash is shown in Fig. 9.

The shale ashes are collected in two large bins, whence they are discharged and mixed in the usual way with the crushed limestone. The raw grinding takes place in two ball mills, System Krupp, and three tube mills. The raw cement is conveyed away on a steel conveyor belt, 85 m. long Fig. 10, which carries over 15 tons of raw cement an hour.

CALCINING OF THE CEMENT

The cement is calcined in two new kilns Fig. 14 with ground coal, but there are also appliances for calcining with crude oil, which could be obtained cheaply from Russia before the War. The clinker is stored in a large storage place behind the rotary kiln house.

FINISHING OF THE CEMENT

The cement is ground in a Kominutor and tube mill, System F. L. Smidth, Copenhagen. The ground cement is removed on a steel belt conveyor, 170 m. long, which dumps the product on a 240-meter long steel belt, serving to distribute the cement in the packing silo. These two belts have been in use 12 years, and will last several years yet, although repaired. The long distance from the factory to the cement storage bins makes it impossible or unsuitable to use worms and trucks, and the steel belt conveyor has solved the conveyor problem in a highly satisfactory manner Fig. 8. The company is now building a new silo for storage of 50,000 bbls., with facilities for packing the cement in sacks and barrels, which need only be transported a few yards for loading on vessels. The company has an excellent harbor of its own, with 17 ft. of water. It also owns a cooperage shop, equipped with machines, made by the well-known German firm, Böttcher & Gessner's, of Hamburg, for making barrels with wooden and iron hoops. The capacity is 1200 bbls. a day.

In addition, the company has a small factory for the manufacture of the paper sacks now used almost exclusively in place of the jute sacks used before the War. During the War, the latter could not be procured, and paper sacks were substituted. The paper sacks are folded and pasted, and are tied at the corners with twine, this whole work being done by girls. The paper sacks are as strong as jute sacks, stand sea transportation and transfers, and are very much liked on account of not emitting any dust during the filling and transport. It has further been proved that the paper protects the cement better against moisture than the jute sacks.

The electric power plant of the company supplies power for the whole works. It consists of four Babcock & Wilcox boilers, a Ljungstrom steam turbine, direct-connected to two generators of 1000 k.w. The reserve plant consists of a 500 h. p. De Laval steam turbine, and 350 h. p. Diesel engine. Any shut down of the main power plant will consequently not affect the operation of the factory.

A steel belt conveyor is also used in the power plant for the conveyance of coal from the trucks to a coal storage bin holding 2000 tons Figs. 12 and 13.

Belonging to the works are also workshops, stores, workmen's dwellings, and houses for officials, hotel, retail shop, etc. The works, therefore, compose a self-contained industrial community in the otherwise rather isolated island.

Machinery for the Trinity Portland Cement Co.'s new plant near Fort Worth, Tex., is arriving daily. The steel superstructure for the rock storage house is going up rapidly and will be completed in the near future, according to word from Fort Worth.

E. D. Roberts formerly chief engineer at the Sun Portland Cement Co.'s plant at Lime, Ore., has been appointed assistant professor of civil engineering on the faculty of the Marquette University College of Engineering at Milwaukee, Wis.

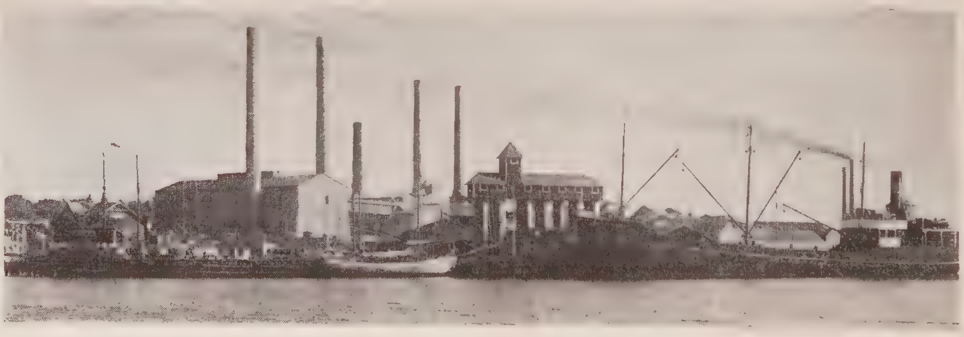


FIG. 16—VIEW OF DEGERHAMN, SHOWING WATER FRONT AND CEMENT PLANT

Ship Canal Portland Cement Plant

Courtesy of The Ship Canal Portland Cement Manufacturers Limited and *The Journal of Commerce.*

The Ship Canal Portland Cement Manufacturers, Limited, has completed its plant at Ellesmere Port, where it produces the famous England brand portland cement. Prior to the establishing of this plant, shipowners and exporters trading from shipping ports of the magnitude of Liverpool and Manchester were placed at a considerable disadvantage in comparison with shippers from the Thames, Bristol Channel, and the Humber, in not having in the locality of the River Mersey a cement factory from which to ship supplies of cement.

The installation of this plant at Ellesmere Port has remedied this condition, and shipowners and traders now have the advantage of being able to draw supplies from a local factory, with a productive capacity of about 5000 tons of cement per week.

Broadly speaking, the company has built its works and business during the years of war and the early years of peace. During the war period, its handicap in erecting and producing was great, due to the cement industry not being recognized as a key industry, and the handicap in the years of peace was hardly less great, caused by epidemics of strikes throughout the country.

Raw Materials

The raw materials from which England brand portland cement is produced are limestone and shale, obtained from the company's own quarries. In these properties, the company possess raw materials of such quality and regularity in chemical composition as to ensure, with adequate care in the process of manufacture, the production of portland cement of high quality.

The plant is situated on a unique site of about 60 acres freehold land, with frontages to the Manchester Ship Canal, Shropshire Union Inland Canal, and direct railway connections with the London & North Western and Great Western Railway. The site was chosen expressly for the purpose of cutting out transit delays, so as to serve expeditiously all natural markets—home, coastwise, and abroad, by rail, road, inland canal, and by direct shipment to all parts of the world from the company's own deep water wharf at the plant.

In its quarries in North Wales, the company has inexhaustible supplies, not only for the present capacity of the cement plant but also for practically unlimited extension thereof. It is interesting to know that from its Little Orme limestone quarries, in addition to shipping limestone used as raw material for the manufacture of its cement, it also supplies this limestone for blast furnace and chemical uses. The material is, speaking commercially, pure carbonate of lime.

Carbo-Limo

From this limestone the company prepares and markets a commodity in the form of an extremely fine powder under the trade name of Carbo-Limo for agricultural and many other purposes.

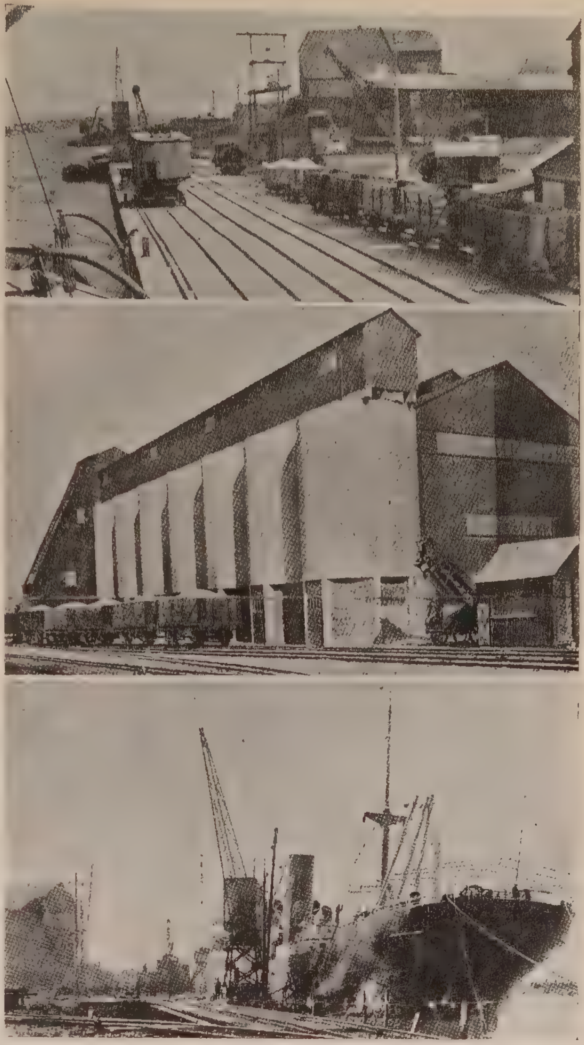


Fig. 1—View of Wharf from Liverpool End, Showing Ship Canal Company's Private Wharf on the Manchester Ship Canal, 4 Miles from Eastham. The Wharf Holds All Records for Despatch in Loading and Discharging. Depth of Water, 28 ft. Minimum at All Times

Fig. 2—Exterior View of the Raw Material Grinding Plant, Showing Concrete Storage Bins from Which the Chemical Mix is Proportioned

Fig. 3—S. S. Dryden, Loading Casks of England Brand Portland Cement at the Company's Wharf for Rio de Janeiro

Loading and Discharging Facilities

The actual work of the factory commences at Stanlow Wharf—the company's private wharf on its estate—a structure substantially built which presents a frontage of about 1000 ft. to the ship canal.

The plant site for the production of England brand portland cement was chosen because of its ideal situation for transit facilities. Ocean liners of a capacity up to the maximum that can navigate the ship canal—20,000 tons burden—can be accomodated at the company's wharf, where there is a minimum depth of 28 ft. of water at all times. In addition to these facilities, the proximity to the ports of Liverpool and Manchester places this plant in direct connection with all parts of the world.

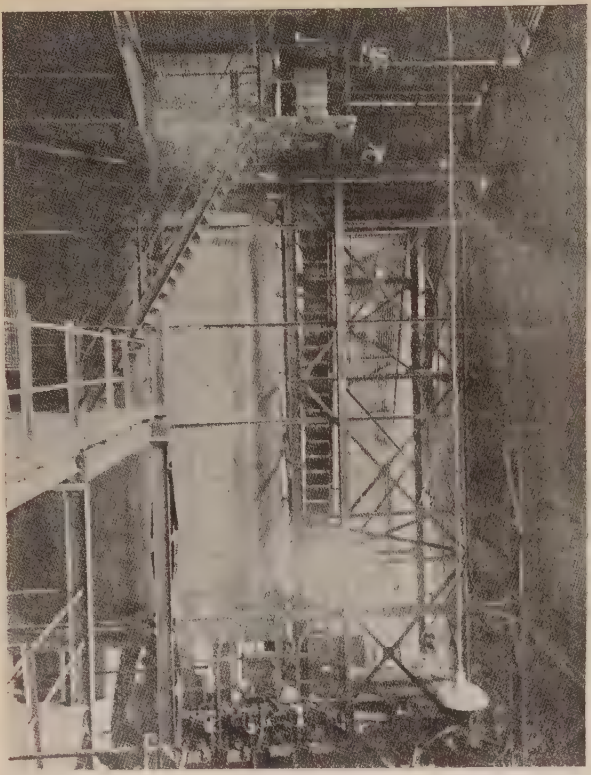


Fig. 4—Interior View of Elevator House, Showing Elevator with Capacity of 150 Tons per Hour, Carrying Raw Materials to the Conveyors over the Top Level of Storage Bins

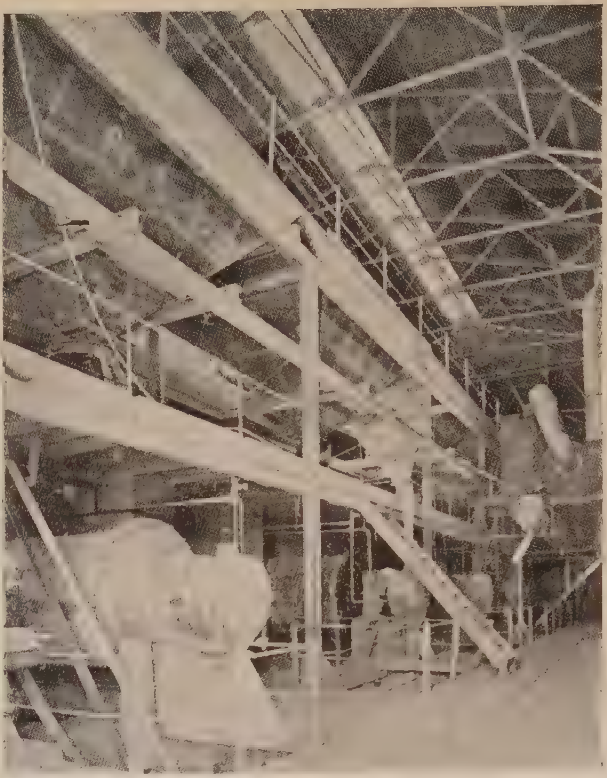


Fig. 5—Discharge End of the Clinker Pulverizing Mills and the Raw Material Grinding Plant

Equipment of Wharf

The wharf is equipped with electric and steam cranes for rapid dispatch of all tonnage, the company performing loading and stowing services at record speed. Being a sufference wharf, custom clearances, including bonded goods and stores are given at the company's wharf, enabling tonnage to sail direct to and from foreign ports.

The limestone is brought to this wharf in coasting vessels of various sizes, and as work is carried on day and night, there is no delay in discharging. Steam and electrically driven cranes equipped with special grabs quickly discharge the steamers, the limestone being carried to the storage bins by a series of belt conveyors running under the wharf to elevators serving belt conveyor systems running over the wharf storage bins. These bins have a storage capacity upwards of 12,000 tons. From the wharf storage bins, facilities are provided for the conveyance of the stone to the factory or if required, into the company's or other railway cars or barges alongside the wharf. Most of the consignments from the quarry are used in the factory inself. Before leaving the quarry, the stone required for the manufacture of cement is broken to 1¼-in. and down, and for carbo-limo to approximately 6-in. pieces. The larger stone after discharge is conveyed under the wharf and elevated to the crushing department adjacent to the wharf and is broken by means of a jaw crusher to 3 in. and then passed through Jeffrey mills[1] to be pulverized to 1¼ in. and down ready for the factory.

The stone, when required in the factory, is extracted from the bins through chutes in tunnels beneath the bins, the gravity system adopted being simple and effective. Through the chutes, the stone runs into one-yard cars and is drawn by a 2-ft. gauge locomotive to the factory.

Raw Material Grinding Plant

Part of the raw material arrives by rail in addition to the water-borne traffic previously mentioned. Special railway trucks are employed to bring the shale from the quarry and the cement company's special train is known locally as the Ellesmere Port Express. The 15-ton cars are hoppered and provided with bottom doors mechanically operated. As each car is in turn halted over an underground hopper, the bottom doors are released and the shale dumped by gravity into a bucket elevator.

On being discharged from the wagons, the shale is elevated and carried on belt conveyors to three large reinforced concrete silos. There are seven of these silos in all, the other four being reserved for the limestone. From these storage silos are drawn the limestone and the shale in the required proportions (determined by measurement), and the resultant mixture of stone is carried by belt conveyor to the elevator, by means of which it is again raised and passed into steel feed bins for the grinding mills.

As the stone is fed to ball mills, water is added. These ball mills are steel-lined cylinders loaded with steel balls of varying sizes, which, as the mills revolve, cascade and grind the stone. When the slurry leaves the mills, it is conveyed by elevators to trix machines which separate the product, the fine material passing to the distributors to be fed to the tube mills and the coarse particles being returned to the ball mills for further grinding. The tube mills are cylinders lined with stone and loaded with flint pebbles.

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[1] Jeffrey Mfg. Co., Columbus, Ohio.

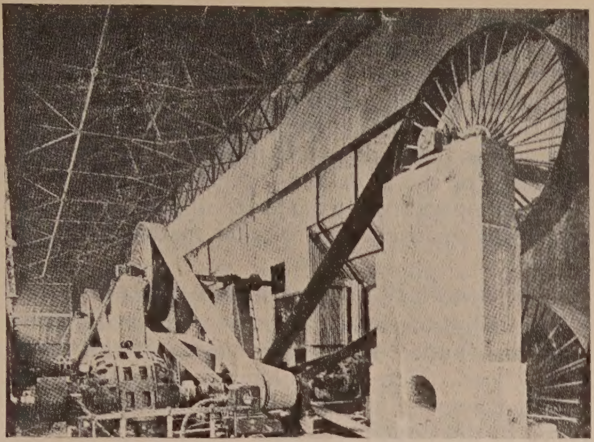


Fig. 6—The Drives in the Clinker Pulverizing Department. Similar Drives Are Used in the Raw Material Grinding Plant. The Illustration Shows 350 h. p. Motors and 3000 Volt A. C. Motors

How the Slurry is Treated

When this material finally leaves these tube mills as slurry, it is carried by means of troughs to the slurry tanks. These are circular tanks constructed of reinforced concrete 66 ft. in diameter and 13 ft. deep. A mixing plant fixed on a center base keeps the mixture in motion.

This device is known as the Sun and Planet mixer, the revolving arms of the apparatus being carried across the tank, while at the same time the whole contrivance moves slowly around the tank. Thus every part of the mixture in the tank comes within the scope of the revovling arms in turn, and the tendency to settle is arrested.

The slurry is then raised as required, by means of three-throw slurry pumps, to a pipe line feeding other slurry tanks at the base of the rotary kilns, from which it is pumped up to the kiln feed. The quantity passing into the kilns can be regulated, separately for each kiln, according to requirements, the whole being regulated on the firing, platform by the operator in charge of the kilns.

The Rotary Kilns

The plant has two steam (not smoke) stacks, 200 ft. high, built of reinforced concrete, and three steel stacks of smaller dimensions visible for miles around with steam issuing from them day and night throughout the year. Attached to these stacks are the 5 rotary kilns, three, each 130 ft. long by 8 ft. diameter, and two, 200 ft.

Fig. 7—View of Nos. 4 and 5 Kilns with Coolers Taken from the Ground Floor, Showing the Connection to Gravity Bucket Conveyor

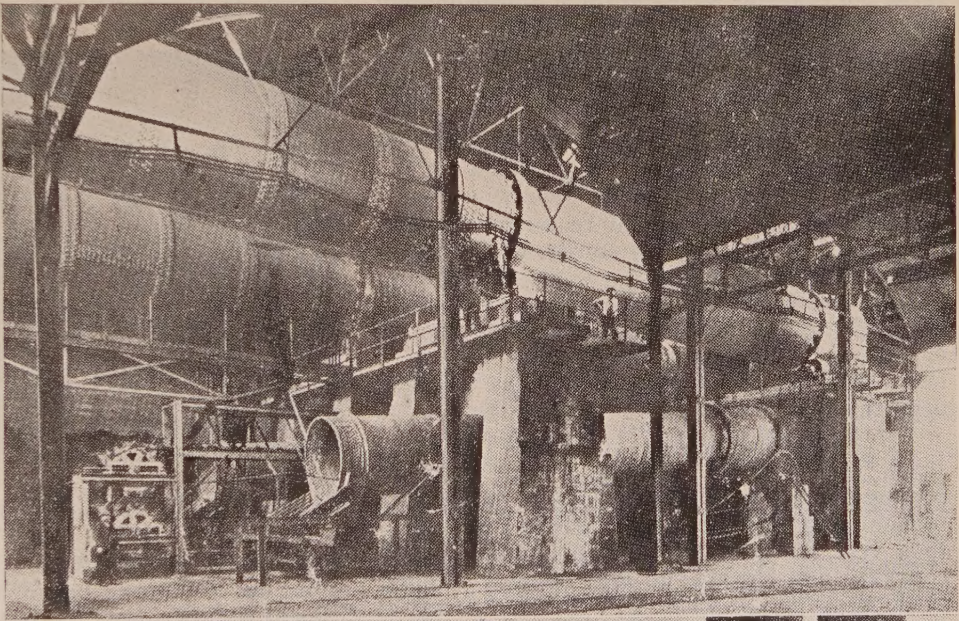
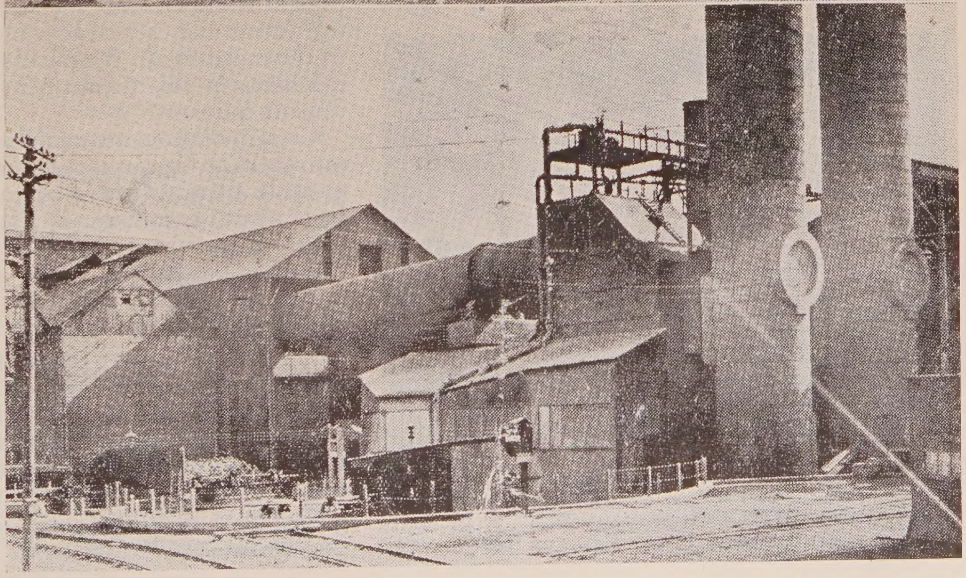


Fig. 8—End View of No. 5 Kiln and Nos. 4 and 5 Stacks, Showing Nos. 3 and 4 Slurry Tanks and Exterior of Pump House with Kiln Feed



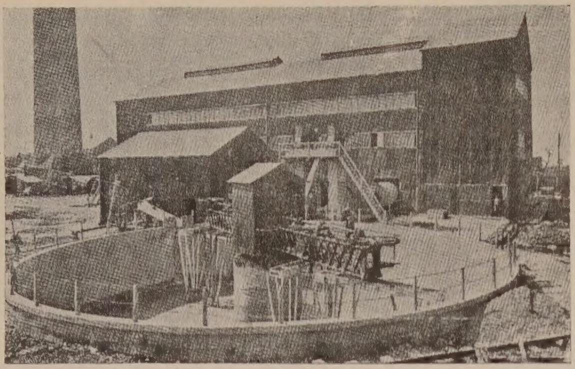


Fig. 9—View of the Discharging Side of the Raw Material Grinding Plant Delivering to No. 1 Slurry Tank

long x 9 ft. diameter and 10 ft. in the burning zone. These kilns are lined with special firebrick, are mounted on rollers, and slowly rotate at varying speeds as required. They are motor driven with suitable gearing. The slurry is pumped from the tanks below and falls in measured quantities at a regulated speed into the raised ends of the rotary kilns, down which it travels by gravity, meeting the heat from the burning zone, where there is a constant temperature of approximately 3000° F. The clinker discharges into 70 ft. coolers. These coolers discharge the clinker to a gravity bucket conveyor which carries it directly to the belt conveyor feeding the hoppers over the clinker pulverizing mills or conveys it to the clinker storage.

Clinker Storage

All clinker not immediately required for grinding is conveyed to a clinker storage of 7000 tons capacity. The surplus clinker is deposited at any point down the center of this storage by a simple device for tipping each bucket of the conveyor as it passes. The conveyor also recovers the clinker from the storage as required by the grinding department.

Coal Pulverizing Department

The coal used for calcining is first dried by passing through revolving dryers and then passed to high speed pulverizing mills, where it is reduced to a very fine powder. The pulverized fuel is conveyed and elevated to feed hoppers situated at the firing end of the kilns, each kiln having its own hopper. It is then conveyed through a pipe by means of an air blast into the kilns, where the volume of pulverized fuel immediately ignites in the burning zone. The pulverized coal hoppers and the coal feed apparatus are situated on what is known as the firing platform, where the operator in charge of the kilns has complete control of all the kiln operations by means of the ingenious system of electrical control gear installed on this platform.

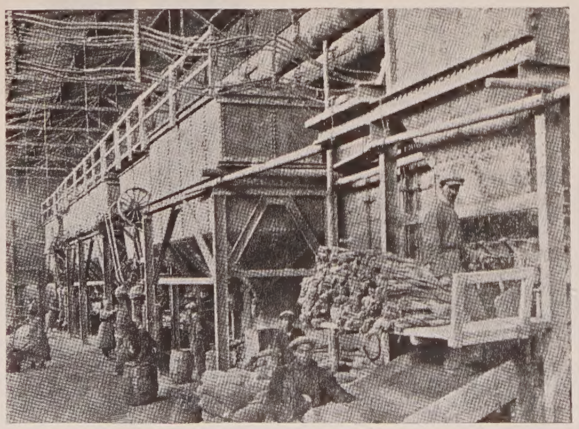


Fig. 10—View of the Packing Platform, Illustrating Three Methods of Packing. Reading from the Right: 1 Cwt. Bags; by Hand by Sleeves from Bins; by Machines Packing under Pressure Either Casks or Bags

Clinker Pulverizing Department

The mills consist of batteries of ball and tube mills and Fuller[2] and Griffin[3] mills of the high-speed type. Here the clinker is ground to the required fineness and the finished cement is conveyed to the cement storage.

Cement Storage

The storage consists of reinforced concrete bins with a capacity of about 15,000 tons, and here the cement is retained until required for shipment to customers. The system of depositing and recovering the cement is by conveyors of the steel worm type, and elevators. This storage adjoins and runs the full length of the packing department.

Packing and Loading

The packing department is a model of ingenuity and convenience. On one side are the packing machines which are separated from a railway siding by a working platform of concrete. The cement is drawn from the storage bins by extracting worms and carried by conveyors and elevators to the machines in the packing department. The machines in this department are unique for the cement industry.

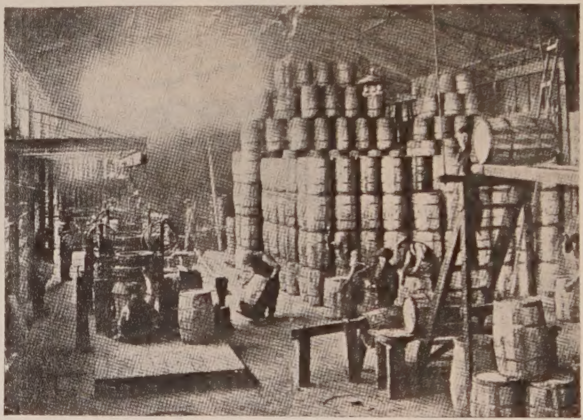


Fig. 11—Cooperage—View of the Trussing Bells, Which Are in Line on the Left Hand Side

Certain of them are equally suitable for packing into sacks or bags or into casks as required. These work in pairs. Others contain spouts for filling bags alone, automatically, four at a time. The sacks on the other machines have to be tied and the casks headed up.

The filled sacks and casks are trucked across the platform to the waiting cars, for conveyance inland by rail or to the wharf for shipment to other parts in the British Isles or abroad. Cars of various railway companies, or the cement company's own cars, are used according to destination. Arrangements are provided for loading large quantities onto motor vehicles. The company runs a number of its own vehicles and delivers the cement direct to the job.

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[2] Fuller-Lehigh Co., Fullerton, Pa.

[3] Bradley Pulverizer Co., Allentown, Pa.

Special Cask Packing for Export

The company packs its casks by a unique method with special machines to ensure the casks reaching their overseas destinations with their contents intact, both as to quantity and quality. At its works the company has a cask of England brand portland cement that has traveled practically around the world, covering a period of over 15 months. Notwithstanding having passed through varying climatic conditions, both the package and contents are in perfect condition.

The Cooperage

A cooperage fully equipped with the most modern cask-making machinery has been installed in a separate building in which the whole process of cask making is efficiently carried out. On the company's estate are stacked thousands of tons of stavewood, awaiting the call of the coopers. The stavewood when wanted is taken to the cooperage, shaped at the ends for casks, tongued, grooved, heated, hooped, etc., until having gone from end to end of the building and passed through a score or more different hands, it finally emerges the finished cask, only awaiting the cement, the head and the labels to be ready for its journey to some far-off country. Any size and kind of cask can be supplied according to customers' requirements.

Carbo-Limo Pulverizing Department

Carbo-Limo is the finest grade carbonate of lime, being the limestone from the company's own quarries pulverized to a fine powder by the special machinery at the plant. This department is equipped with large storage bins for the raw materials; batteries of high speed and ball and tube mills; storage bins for the finished product, all connecting and served by elevating and conveying plant similar to the other pulverizing departments. This department has a productive capacity of 6000 tons of carbo-limo per week.

Dust Collectors

At this plant a system of dust collectors has been installed at considerable expense in all grinding departments and the absence of dust is particularly noticeable. The principle function of these dust collectors is to draw the dust and steam from the delivery end of each mill and dryer. The steam and dust thus drawn into the machines are separated in special flannel bags in a series of chambers, the dust being retained and the moisture passing to atmosphere.

The Laboratory

From the loading of limestone at the wharf or of the shale at the factory to the time the finished cement is loaded into trucks for dispatch, the chemist is very much in evidence. The properties of the limestone and the shale are tested and the mixture of the two proportioned so as to ensure uniformity in the resultant slurry. Constant tests are made of the slurry up to the point of being fed to the kilns, and this work proceeds at stated intervals night and day. In fact, the testing work proceeds constantly without intermission from the time the raw materials are received at the plant until the finished product is dispatched. The remarkable feature is that owing to the uniformity of the chemical analysis of the raw materials and the excellent proportioning arrangements, the company has never found it necessary to put into operation the doctor (i. e. regulating) plant installed at considerable expense in connection with the raw material grinding department. Incidentally it may be mentioned that the laboratory is placed at the service of the company's customers to investigate the character of their aggregates and to give advice generally.

Power

The plant machinery is electrically driven throughout. The development of the company's undertaking has hitherto been retarded by the inadequate supply of power produced from its own power plant. To overcome the inadequacy of the power and to serve the whole of its power requirements, including that for the plant just completed, the company contracted with the Mersey Power Co. for a bulk power supply from that company's Weston Point power station. This supply was connected up to the plant at the beginning of 1922.

This current is delivered at 33,000 volts from the Mersey Power Co.'s new station at Weston Point, Runcorn, through a duplicate set of mains laid along the bank of the ship canal to the power station on the cement plant estate. This current is passed through transformers and delivered to the cement company's equipment at 3000 volts for the 350 h. p., A. C., 3-phase motors driving the ball and tube mills in the wet and clinker grinding departments, and at 440 volts, A. C., 3-phase for the other motors.

The voltage for lighting and sundry motor driven accessories being 250 volt D. C., a 440 volt connection is passed through the cement company's own sub-station and is reduced by rotary converters to 250 volts D. C. as required. The current is delivered to the various departments through cables hung on brackets in covered concrete trenches, in which are also laid water, slurry and other service pipes, the whole installation being very accessible.

As an ample and reliable power supply is the life's blood of any cement factory and the ideal condition is to operate continuously, the cement company has installed excellent switchboards and electrical gear. The plant is also provided with up-to-date mechanics', electrical and joiners' shops to effect speedy repair and constructional work.

Air-Nitrogen in Alumina Cement

By E. Lee Heidenreich

Extracted from an article by Dr. Adolf Spengel in *Tonindustrie-Zeitung.*

While 25 years ago the nitrogen of the air was considered of no commercial value, the progress in inorganic chemistry during the past ten years has succeeded in furnishing us three different methods of transforming this nitrogen into chemically fixed and valuable forms.

The three methods of actualizing the potentiality of the nitrogen are:

1. Haber's method of producing ammonia from the comopnents.
2. Lindke-Frank-Caso's calcium cyanamid.
3. The Serpekish patents for aluminum nitride, AIN.

The latter produces the connection between the action of air-notrogen and alumina cement (ciment fondu), bauxite, which is the raw material for both, being the connecting means of this method.

Nitride of aluminum results from heating bauxite in a current of nitric generator gases of 1600° to 1700° centigrade, and the result consists of a more or less rich aluminum hydrate, according to the richness of the bauxite—and which in wet crushers are mixed with ground lime, and burned in special kilns. The result now is the ciment fondu, (shmelzzement).

The use of a combination of the methods 2 and 3 reduces the cost of the alumina cement to one-half or one-third of the original ciment fondu, as produced in electrical furnaces—on account of the extreme heat (up to 3000° C.) required in these furnaces.

This brings the cost of the new alumina cement not far above that of portland cement, and considering its compression-cost value, even less than the latter.

The following table gives a comparative idea of this compression-cost for 2, 7 and 28 day tests of the two cements:

	2 days	7 days	28 days
Portland Cement	6.60	2.66	2.22
Alumina Cement	2.92	2.08	1.95

Alumina cement is far more elastic than portland cement, the coefficient of elasticity being determined at nearly 5,000,000 lbs. per sq. in., so that steel of high elastic limit may be used to greater advantage and with greater safety.

To use electric ovens for alumina cement—in Germany—is, according to Dr. Spengel, "to use cannons for shooting sparrows."

C. H. Sonntag has severed his connection with the Cape Girardeau plant of the Marquette Cement Manufacturing Co., after having been with the Marquette company and its predecessor, the Cape Girardeau Portland Cement Co. at Cape Girardeau, Mo., over thirteen years. Mr. Sonntag's successor is F. S. Richards, who has been in charge of construction work at the Cape Girardeau plant and whose previous connection was with the Kandos Cement plant in Australia.

The Vulcanite Portland Cement Co., announces the removal of its offices from Land Title Building to 1219-22 Packard Building, S. E. Corner 15th & Chestnut Sts., Philadelphia, Pa.

The Sun Portland Cement Co., Lime, Ore., which began operations in February with a daily output of 1000 bbls. of cement will have a successful year, says George MacDonald, vice president of the company.

Several shareholders of the Oregon Portland Cement Co. are interested in the Sun company.

On September 3, the Penn-Allen Cement Co. moved its general sales offices to 1609-10 Packard Bldg., 15th & Chestnut Sts., Philadelphia, Pa.

The Bath Portland Cement Co. will shortly begin the erection of a large mill and power house on the tract of land at Sandt's Eddy on which the old Quaker Portland Cement Co. had planned to build a cement plant.

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